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4 December 2017

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800 N. Last Chance Gulch
Helena, Montana 59601

Mr. Brett McCully
Director of Operations
Lincoln County Port Authority
P.O. Box 1071
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Libby, Montana 59923

Subject: Final Test Pit Soil Sampling Summary Report
Operable Units 5 & 6 - BNSF Stimson Spur
K/J 1749206.00

Dear Yueh:

On behalf of BNSF Railway Company (BNSF), Kennedy/Jenks Consultants performed test pit soil sampling within the Stimson Spur industrial railroad spur (Site) during April 2017. The work was completed in accordance with the *FINAL Field Sampling Plan – Stimson Spur Test Pit Soil Sampling, Libby Asbestos Superfund Site, Operable Unit 6, Libby, Montana* (FSP) (Kennedy/Jenks Consultants 2017), with the deviations discussed below. The FSP is an addendum to the *Final Quality Assurance Project Plan* (QAPP) (Kennedy/Jenks Consultants, 2016), which is the governing document.

The Site is located on the eastern side of the town of Libby, Montana, and is situated on BNSF-owned property incorporated into Operable Unit 6 (OU6) of the Libby Asbestos Federal Superfund Site. OU6 consists of the BNSF right-of-way (ROW) rail corridor, beginning east of Libby at approximate railroad milepost (MP) 1301 and running westerly through the town of Troy, Montana, ending at approximately MP 1342. According to the record of decision (ROD) (EPA 2016), OU6 is defined as a transportation corridor, based on current and projected land use.

On behalf of BNSF, Kennedy/Jenks Consultants has prepared this Test Pit Soil Sampling Summary Report (Report). The Report summarizes soil sampling activities conducted at the Site and the analytical laboratory results associated with the samples collected.

SITE BACKGROUND AND HISTORY

Libby is a community in northwestern Montana located seven miles southwest of a vermiculite mine that operated from the 1920s until 1990. The mine began limited operations in the 1920s

and was operated on a larger scale by W.R. Grace and Company from approximately 1963 to 1990. Studies revealed that the vermiculite from the mine contains amphibole-type asbestos, referred to as Libby Amphibole asbestos (LA).

Epidemiological studies revealed that workers at the mine had an increased risk of developing asbestos-related lung disease (McDonald et al. 1986; Amandus et al. 1987; Amandus and Wheeler 1987; Sullivan 2007; Larson et al. 2010, 2012a, 2012b). Additionally, radiographic abnormalities were observed in 17.8 percent (%) of the general population of Libby including former workers, family members of workers, and individuals with no specific pathway of exposure (Peipins et al. 2003). Although the mine has ceased operations, historical or continuing releases of LA from mine-related materials could be serving as a source of ongoing exposure and risk to current and future residents and workers in the area. The Site was listed on the National Priorities List in October 2002.

The Stimson Spur is an industrial railroad spur located on the eastern side of the town of Libby that formerly served Stimson Lumber Yard and other local industries (Figure 1). The Stimson Spur is located on land incorporated into OU5 (Stimson Lumber Mill properties) and OU6 (BNSF ROW rail corridor). A portion of this spur, referred to as the West Leg of the Stimson Spur, was removed in 2010 from a point east of the Libby Depot to a point near East 3rd Street (Photo 1) (EMR 2010). BNSF and Lincoln County Port Authority (LCPA) are working together to reinstall and reconfigure the West Leg of the Stimson Spur to improve rail access to the City of Libby. Much of land within OU6 that will be affected by the track reinstallation was sampled in the early 2000s during soil characterization efforts related to the Libby Railyard. The test pit (TP) investigation, described in this Report, will address the portion of OU6 that has not been previously characterized, herein referred to as the Investigation Area (Figure 2). The portions of the track reinstallation project area lying within OU5 were previously characterized under the *Operable Unit 5 Railroad Spur Investigation Quality Assurance Project Plan* (USACE 2014).

PROJECT RATIONALE

BNSF and the LCPA are working together to improve rail access to the Stimson Spur to encourage development of the former Stimson Lumber property in OU5. According to information provided by LCPA, the West Leg of the Stimson Spur will be reconstructed and realigned to lessen track curvature. The proposed track alignment will intersect the Investigation Area, which is BNSF-owned property that has not been previously sampled. This investigation was conducted to satisfy BNSF requirements for construction and lease development. Although this work was not mandated by the United States Environmental Protection Agency (EPA), the sampling strategy and procedures followed Libby-specific procedures and methodologies, adopted for application in OU6.

According to the ROD, the Transportation Corridor remedial action level (TC RAL) defines the condition when remedial action is and is not needed due to LA contamination in soil. Since the Investigation Area falls within OU6, the TC RAL is applicable to the soil sample results of this investigation. The TC RAL is defined as an LA concentration of Bin C by polarized light

microscopy (PLM) - visual estimation (VE) [PLM-VE] and PLM-Gravimetric (PLM-Grav) (i.e., LA is present at levels greater than or equal to 1%) (EPA 2016).

The two primary objectives of this test pit investigation were to:

1. Collect soil data to confirm the presence or absence of LA in the Investigation Area soils.
2. Compare LA concentrations in soil samples collected as part of this test pit investigation to the TC RAL to determine if physical cleanup actions will be required prior to construction.

The extent of the Investigation Area is shown on Figure 2.

FIELD ACTIVITIES

Test pit soil sampling was completed on 20 April 2017 by Kennedy/Jenks Consultants' personnel. Olympus Technical Services, Inc. (OTS), a BNSF contractor, was responsible for digging the test pits, backfilling and site restoration. EPA representatives were not present during the test pit investigation and soil sampling discussed within this report.

Test Pit Investigation

The Investigation Area measures approximately 120 feet by 22 feet and is situated approximately 1,100 feet southeast of the Libby Amtrak Depot. As per the FSP, six pits were completed, beginning at the northern end of the Investigation Area with TP1 and continuing in a southerly direction to TP6 as shown on Figure 2 and Photographs 1 through 3 (Attachment A). Visible vermiculite (VV) was not observed on the surface of the Investigation Area or within any of the test pits.

Kennedy/Jenks Consultants' personnel used a sub-meter global navigation satellite system (GNSS) receiver paired with an Apple iPad tablet running ArcGIS Collector software to locate test pit locations (Final Quality Assurance Project Plan Revision 1, Appendix B, "Addendum to CDM-Libby-09, Revision 5 Revision 0"). The test pit locations were designated with orange pin flags (Photograph 3). Test pits were equally distributed throughout the Investigation Area, with three pits located along the proposed track centerline, two pits located east of the proposed centerline, and one pit located west of the proposed centerline (Figure 2).

Six test pits were completed to a depth of 36 inches below ground surface (bgs). Two soil stockpiles were generated from the soil excavated from each test pit – one composed of soil removed from a depth of 0 to 18 inches bgs, and the second composed of soil removed from a depth of 18 to 36 inches bgs. Two 30-point composite soil samples were collected and submitted for laboratory analysis. One 30-point composite soil sample (BG-00332) consisted of five individual aliquots collected from each of the six stockpiles from the 0-18 inch bgs interval. The second 30-point composite soil sample (BG-00333) consisted of five individual aliquot samples collected from each of the six stockpiles from the 18-36 inch bgs range. Between 500

to 1,000 grams of soil were placed in a 1-gallon plastic re-sealable bag and labeled with a unique sample identification sticker provided by CDM Smith. Debris, vegetation or other material, greater than 0.75 inches in diameter, was removed from the composite samples prior to sealing the bag.

A field sampling data sheet (FSDS) was completed for the two soil samples collected during the Investigation (Attachment B). Samples and FSDSs were submitted to the CDM Smith sample coordinator in Libby for chain-of-custody development and laboratory submission, as specified in the Field Sampling Plan (FSP).

Upon completion of soil sampling activities, OTS returned the stockpiled material to the test pits. Test pits were then compacted and smoothed to eliminate the potential for trip and fall hazards as shown in Photographs 4 through 6 (Attachment A).

Personal air sampling was not conducted as part of the test pit soil sampling. On-site personnel utilized Level D personal protective equipment (PPE), upgraded to include respiratory protection.

FSP Deviations

A duplicate composite soil sample was not collected as part of the test pit soil sampling procedures. Therefore, a record of modification (ROM) detailing the deviation from the FSP is being submitted as Attachment C.

LABORATORY RESULTS

Sample Analysis

Soil samples were prepared for analysis by the TechLaw soil preparation facility in Troy, Montana, and subsequently analyzed by the Environmental Services Assistance Team Region 8 laboratory (ESATR8) for LA, other amphiboles, and chrysotile. Samples were analyzed in accordance with FSP Analytical Requirements Summary #OU6BG0317 – Revision 2 (Kennedy/Jenks Consultants 2017) by PLM-VE and PLM-Grav using methods SRC-Libby-03 (Rev 3) and SRC-Libby-01 (Rev 3), respectively.

Sample Results

Soil sample BG-00332 contained both fine and course grained fractions and was analyzed using both PLM-VE and PLM-Grav methods. BG-00333 did not contain a course fraction and was subsequently analyzed using only the PLM-VE method. PLM-VE analysis of soil samples BG-00332 and BG-00333 resulted in a Bin A classification (LA was not observed) for LA. No other amphiboles or chrysotile were observed in soil samples BG-00332 and BG-00333. Results from PLM-VE analyses were below the TC RAL.

PLM-Grav analysis of soil sample BG-00333 was non-detect for LA, other amphiboles or chrysotile.

Soil sample analytical results are summarized in Table 1. PLM-VE and PLM-Grav laboratory reports and chain-of-custody forms are found in Attachments D and E, respectively.

Data Validation

Kennedy/Jenks Consultants validated laboratory results for the confirmation soil samples using validation protocols established in standard operating procedures (SOP) QATS-70-094-01, the *SOP for the Validation of Libby PLM Data Deliverables*[1].

The data validation results for each laboratory batch of deliverables are summarized on the Data Review Checklists provided in Attachment F. As described below, the soil data validated for this project met the laboratory quality assurance/quality control (QA/QC) requirements of the project and are considered acceptable for use in the study without data qualifiers.

Validation Process

The data validation process followed the confirmation soil samples from collection through PLM laboratory analyses. Composite soil samples were submitted by the SPF for analysis by PLM-VE and PLM-Grav using SOP SRC-LIBBY-03 (Rev 3) and SOP SRC-LIBBY-01 (Rev 3), respectively. Both are EPA-approved methods developed for quantifying asbestos in bulk soil samples.

The laboratory which conducted the analyses was ESATR8 operated by TechLaw, Inc. in Golden, Colorado, which is National Voluntary Laboratory Accreditation Program (NVLAP) accredited as proficient for Bulk Asbestos Testing (NVLAP ID Code 200792-0).

A total of two confirmation soil samples were collected and submitted to CDM Smith for chemical of concern (COC) preparation and laboratory submittal. Three laboratory-prepared preparation QC samples (drying blank, grinding blank, and preparation duplicate samples) were added to the COCs and underwent laboratory analysis. A total of seven analyses were performed in two batches; one batch included five soil samples with a fine fraction analyzed using PLM-VE methods, and the other batch included two soil samples with a coarse fraction analyzed using PLM-Grav methods.

The laboratory-provided QC data associated with the batch analyses, and related routine QC data for the period in which the samples were analyzed. The raw PLM-VE and PLM-Grav laboratory reports associated with batch analyses are provided in Attachments D and E, respectively. The routine QC data from the laboratory are provided in Attachment G. Batch backup data to the analysis results included COC forms, case narratives, analytical test reports, and analysis bench sheets with raw data from the analysis. Routine QC data for the period of

[1] The most recent version of QATS-70-094-01 is provided electronically in the Libby Lab eRoom.

analysis include records for daily contamination checks, PLM microscope calibration, refractive index liquid contamination and calibration, laboratory air monitoring (a check for possible cross contamination), air pump calibration, and analytical balance verification. These records are summarized below and are provided in Attachment G:

- A log of Daily Contamination Check for PLM Laboratory Hoods that covers the period when the samples were analyzed. The log indicates no detectable asbestos contamination present.
- Excerpts from PLM-1 Alignment Check (Nikon 50i Pol) Logbook# R8-LB-PLM-035 and PLM-2 Alignment Check (Zeiss Axioskop 40 Pol) Logbook #R8-LB-PLM-036, both with start date 5 February 2016, covering the period of analysis. The log books indicate that the microscopes used for the PLM analyses were properly aligned.
- Refractive Index Liquid Contamination Check Log (B-130) Logbook #R8-LB-PLM-040, start date 1 February 2017, covering the period of analysis. The refractive index liquid used in the analysis did not contain detectable asbestos of any type.
- PLM Laboratory Air Monitoring by TEM-AHERA (Rooms B129 & B130). The most recent quarterly testing was conduction on 3 March 2017 and 15 March 2017 and found no detectable structures. Previous quarterly testing going back to 16 June 2016 were also free of asbestos contamination.
- Analytical Balance Calibration (B130) Logbook $ R8-LB-PLM-038, covering the period of sample analysis. The calibration log for Room B130 indicates that the balance calibration was acceptable on the day of the sample analysis (and preceding and following days).

Kennedy/Jenks Consultants reviewed each data package and verified that the QA processes were followed and that the QC results were within acceptable limits identified in the validation protocols (SOP QATS-70-094-01). Through this validation process, the data were categorized as acceptable and meeting the QA/QC requirements of the validation SOP for the study purposes. None of the data were categorized as incomplete (data were missing or not recorded per the SOP) or rejected (data failed to meet validation criteria).

Soil Sample Analysis Validation

The soil samples were found not to contain observed LA, other amphibole, or chrysotile fibers. The five samples analyzed using PLM-VE methods were classified as Bin A (LA was not observed in the sample), and the two samples analyzed using PLM-Grav methods did not have observed LA, other amphibole, or chrysotile fibers.

PLM data validation checklists are provided in Attachment F.

DATA VERIFICATION

U.S. Army Corps of Engineers (USACE) performed the data verification and provided a verification report. The data verification report concluded no critical errors, potential critical errors or none-critical discrepancies were identified in the verification process for samples analyzed by PLM-VE or PLM-Grav.

The Data Verification Coordinator is required to perform a check of a minimum of 5% of the analyses verified to ensure that any potential issues were identified correctly. Two field-collected soil samples were included in this data verification, 100% of the data was verified. No deficiencies were noted.

The Data Verification report is included as Attachment H.

QUALITY ASSURANCE/QUALITY CONTROL

Field Quality Control Samples

Field Duplicate Samples

Per the FSP, field duplicate samples were to be collected at a rate of 5% (one field duplicate sample per 20 soil samples). A field duplicate sample was not collected, and this deviation was documented by a ROM (Attachment C).

Preparation Quality Control Samples

Grinding and drying blank samples were all non-detect for LA, other amphiboles, and chrysotile, indicating cross-contamination or false-positive results were not present during the analyses processes. The preparation duplicate sample was also non-detect for LA, other amphiboles, and chrysotile, indicating consistency with the parent sample.

Laboratory Quality Control Samples

Inter-Laboratory Analyses

No inter-laboratory analyses were completed.

Intra-Laboratory QC

The laboratory batch QC data provided with the project samples did not include laboratory blank or duplicate data because the batch sizes were small. Previous analyses for this project by this laboratory had acceptable replicate and blank QC data.

DATA VALIDATION CONCLUSIONS

The two analytical batches met the laboratory QA/QC requirements of the project and were considered acceptable for use in the study without data qualifiers. A total of two confirmation samples were collected and successfully analyzed. A total of five samples were analyzed by PLM-VE (including three laboratory-prepared QC samples) and two samples analyzed by PLM-Grav (including one laboratory QC sample), for a total of seven analyses. These seven analyses were validated as acceptable for project use, which meets the project stated validation completeness goal of 100% of the received deliverables. PLM data validation checklists are provided in Attachment F.

CONCLUSIONS

The following are the conclusions of the Test Pit investigation

- Two 30-point composite soil samples were collected, and both were analyzed using the PLM-VE method. Both composite soil samples (BG-00332 and BG-00333) were classified as Bin A (LA was not observed) and LA concentrations are below the TC RAL. No other amphiboles or chrysotile were observed.
- One of two composite soil samples (BG-00332) contained a course fraction and was analyzed using the PLM-Grav method. PLM-Grav analysis of soil sample BG-00332 did not result in the observation of LA, other amphiboles or chrysotile.
- No VV observed on the ground surface of the Investigation Area or in the soils excavated during the Test Pit Investigation.
- Physical cleanup actions are not warranted within the Investigation Area.

Please contact us should you have any questions.

Very truly yours,

KENNEDY/JENKS CONSULTANTS

Scott Carney, P.G.
Project Manager

Enclosure: Tables
Figures
References
Attachment A: Photographic Record
Attachment B: Field Sample Data Sheet
Attachment C: Record of Modification
Attachment D: PLM-VE Soil Sample Laboratory Report

Attachment E: PLM-Grav Soil Sample Laboratory Report
Attachment F: PLM Data Validation Checklists
Attachment G: Routine QC Laboratory Reports
Attachment H: USACE/CDM Data Validation Report

cc: Dania Zinner – U.S. Environmental Protection Agency, Region VIII
Lisa DeWitt – Montana Department of Environmental Quality

Tables

TABLE 1

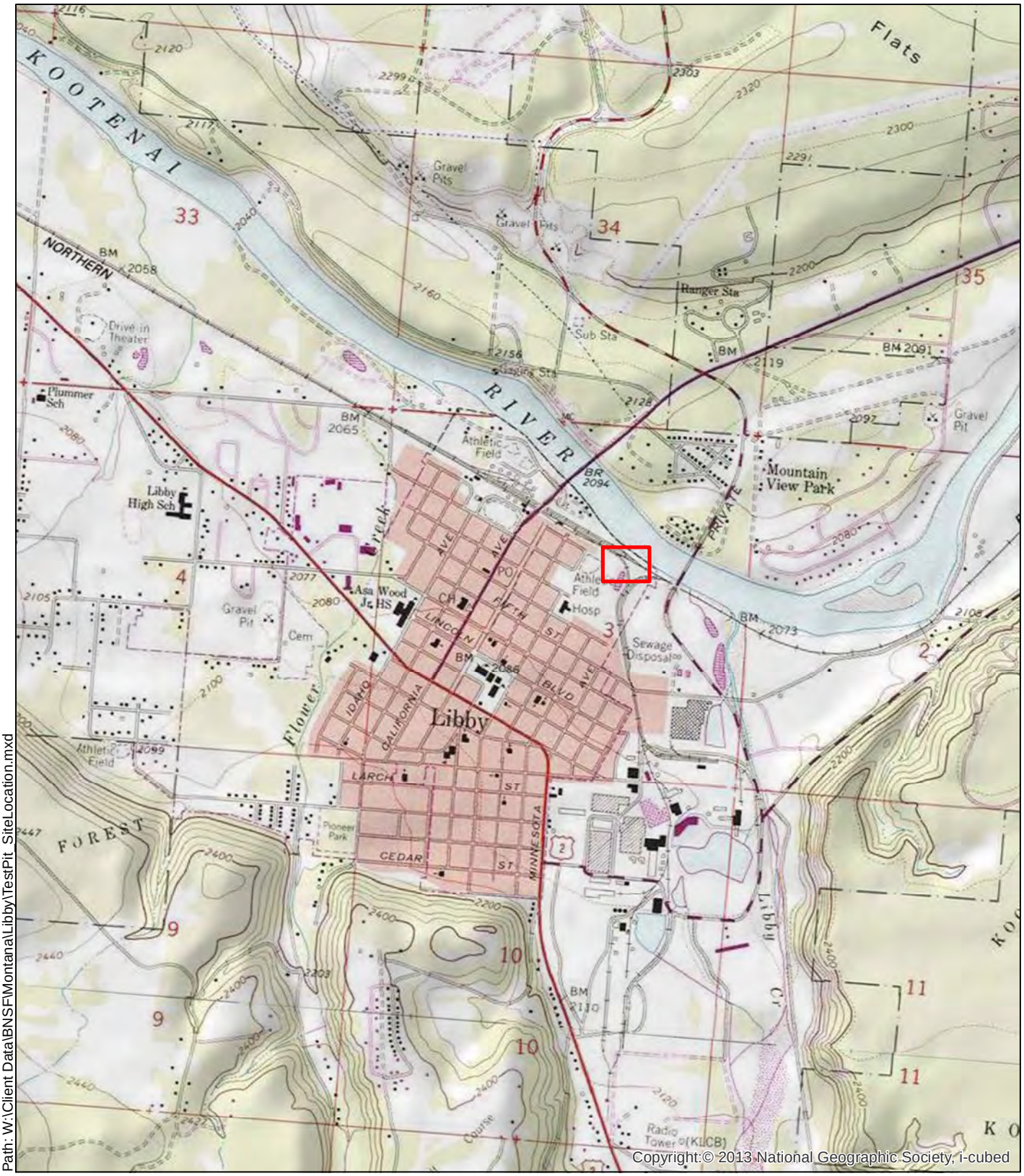
2017 TEST PIT SOIL SAMPLE ANALYTICAL RESULTS
BNSF Stimson Spur Test Pit Investigation
Libby, Montana

Sample ID	Date Collected	Field Duplicate (Y/N)	Sample Interval (in bgs) [a]	QC Sample Type	PLM-VE [b]					PLM-Grav [c]					Location Description (Milepost)
					Chain of Custody ID	Lab Sample ID	LA [d] Qualifier	OA [e] Qualifier	CH [f] Qualifier	Chain of Custody ID	Lab Sample ID	LA Qualifier	OA Qualifier	CH Qualifier	
Right of Way Samples															
BG-00332	4/20/2017	N	0-18	NA [g]	17-1009_FG	A170060-01	ND [h]	ND	ND	17-1009_C	A170059-01	ND	ND	ND	1319.4
BG-00333	4/20/2017	N	18-36	NA	17-1009_FG	A170060-02	ND	ND	ND	NS [i]	NS	NS	NS	NS	1319.4
BG-00334 [j]	4/20/2017	N		Blank-Drying	17-1009_FG	A170060-03	ND	ND	ND	NS	NS	NS	NS	NS	NA
BG-00335 [j]	4/20/2017	N		Blank-Grinding	17-1009_FG	A170060-04	ND	ND	ND	NS	NS	NS	NS	NS	NA
BG-00336 [j]	4/20/2017	N		Prep Duplicate [k]	17-1009_FG	A170060-05	ND	ND	ND	17-1009_C	A170059-02	ND	ND	ND	NA

Notes:

(a) in bgs - inches below ground surface
(b) PLM-VE - Polarized Light Microscopy-Visual Estimation
(c) PLM-Grav-Polarized Light Microscopy-Gravimetric
(d) LA - Libby Amphibole
(e) OA - Other Amphibole
(f) CH - Chrysotile
(g) NA - Not Applicable
(h) ND - Non-Detect (Bin A - LA was not observed)
(i) NS - Not submitted for PLM-Grav analysis, no coarse fraction present
(j) Laboratory-prepared QA/QC sample (drying, grinding blanks or duplicate samples), not field collected samples
(k) Preparation duplicate prepared from field sample BG-00332

Figures



Path: W:\Client Data\BNSF\Montana\Libby\TestPit_SiteLocation.mxd

Legend

Site Location

N

0 2,000 4,000 Feet

Kennedy/Jenks Consultants

BNSF Railway Company
BNSF Operable Unit 6
Libby, Lincoln County, Montana

Site Location

1749206.00
June 2017

Figure 1

Kootenai River

Lands lying west of this approximate boundary have been previously sampled

TP1
TP2
TP3
TP4
TP5
TP6

Proposed Walkway - 11' Offset From Track Centerline

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User

Path: W:\Client Data\BNSF\Montana\Libby\Libby_StimsonSpur_TestPits.mxd

Legend

- Test Pit Locations
- Investigation Area
- Proposed Track Alignment
- Proposed Walkway Offset
- Approximate Boundary of Previous Sampling Efforts
- Approximate BNSF Property Boundary

NOTES:
(1) All locations are approximate.
(2) Proposed track alignment and associated improvements from KLJ Engineering.

N

0 30 60 120 Feet

Kennedy/Jenks Consultants

BNSF Railway Company
BNSF Operable Unit 6
Libby, Lincoln County, Montana

Stimson Spur Investigation Area and Test Pit Locations

1749206.00
June 2017

Figure 2

References

References

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U.S. Army Corps of Engineers (USACE), Omaha District. 2014. *Operable Unit 5 Railroad Spur Investigation Quality Assurance Project Plan, Libby Asbestos Site (Revision 0)*. Prepared by USACE for EPA Region 8. Offutt AFB, Nebraska.

Attachment A

Photographic Record

Photo #1:

Overview of Investigation Area and test pit layout. Orange pin flags (indicated by yellow arrows) designate the location of test pits. No ballast material was observed in the Investigation Area. View to the north toward BNSF mainline. Note: arrows indicate location of test pits 1 through 5. Gravel at left is the location of the former West Leg of the Stimson Spur, removed in 2010.

Photo #2:

Overview of the southwest portion of the Investigation Area showing the location of test pit 6.

Photo #3:

Overview of Investigation Area from the northwest; view to the south. Orange pin flags (indicated by yellow arrows) designate the location of test pits. Former West Leg of the Stimson Spur is visible on the right side of the photo.

Photo #4:

Mini-excavator operated by OTS personnel being used to dig TP1; view to the north toward BNSF mainline track.

Photo #5:

Test pit #3 being backfilled with mini-excavator; view to the north toward mainline tracks and Kootenai River.

Photo #6:

Overview of the Investigation Area after test pits had been backfilled and graded.

Attachment B

Field Sample Data Sheet

5/3/17 AJK

Event ID ~~BG-040116~~ BG-040117

Libby Soil-like Sample & Location
Field Sample Data Sheet

FSDS # **S - 121928**

Address BNSF Libby Railyard

Date 4/20/17

Property ID: AD-000739 Logbook # 2 Page(s) 46 Sampler(s)Ω L. Klein - Kennedy Jenks

	Data Item	1	2	3
*	**Location ID**	XX-046561	XX-046562	
*	**Is this a new Location?**	(Yes) No Revised *If No, "Z" Location Type to Comment 2*	(Yes) No Revised *If No, "Z" Location Type to Comment 2*	Yes No Revised *If No, "Z" Location Type to Comment 2*
*	**Location Type**	LuA	LuA	
*	**Location Description**	Field (unmaintained)	Field (unmaintained)	
	Location Area (ft²) †			
	Location Comment	Grass	Grass	
	Location Comment 2			
	Use Based On / Location Zone	☒Current Use ☐RAFU £ Zone:	☒Current Use ☐RAFU £ Zone:	☐Current Use ☐RAFU £ Zone:
*	**Visible Vermiculite**	N 30 L O M O H O	N 30 L O M O H O	N L M H
*	**Soil Depth Top ††**	0 Inches	~~0~~ 18 SJC 5-9-17 Inches	Inches
*	**Soil Depth Bottom ††**	18 ~~3~~ SJC 5-9-17 Inches	~~3~~ 36 SJC 6-9-17 Inches	Inches
	VV Sub Location	Property (Exterior)	Property (Exterior)	
	Visible Vermiculite Comments			
*	**Sample ID**	BG- 00332	BG- 00333	
*	**Sample Time**	1030	1045	
*	**ABS**	(N) Y	(N) Y	N Y
*	**Sample Venue**	Indoor (Outdoor) NA	Indoor (Outdoor) NA	Indoor Outdoor NA
*	**Sample PrePostClear**	(NA) Pre Post Clear: 1st 2nd 3rd 4th 5th	(NA) Pre Post Clear: 1st 2nd 3rd 4th 5th	NA Pre Post Clear: 1st 2nd 3rd 4th 5th
*	**Sample Type**	(FS) FD Other_____	(FS) FD Other_____	FS FD Other_____
	Delineation Sample?	(N) Y	(N) Y	N Y
	Sample Parent ID			
*	**Composite**	(Y) N	(Y) N	Y N
*	**Sample Aliquots ¥**	(30) Other_____ 0	(30) Other_____ 0	30 Other_____ 0
	Sample Location Description			
	Sample Field Comments	subzones Priority	subzones Priority	subzones Priority

4/20/17 CK

27930

V 150330 *Required Field Ω List company after Sampler(s) if not "CDM Smith" † CAD value may supersede Location Area without revision to FSDS
†† "Soil Depth Top" & "Soil Depth Bottom" refer to VV &/or sample £ RAFU = Reasonably Anticipated Future Use ¥ and Inspection points

For Field Team Completion:	Completed by: CK	QC by: SW	For Data Entry:	Entered by: AJK	QC by: KJK

Attachment C

Record of Modification

Record of Modification

to Documents Governing Field Activities

Libby Asbestos Project

Form No. OU6-000002

Instructions: Complete form and obtain necessary approval(s). File approved copy in the project file and post final version to the Libby Field eRoom.

Requester: Scott Carney Title: Project Manager

Company: Kennedy/Jenks on behalf of BNSF Date: 8 May 2017

Governing document (title and approved date) or SOP (title and SOP number):

Field Sampling Plan - Revision 1 (FSP) (7 April 2017) and Quality Assurance Project Plan (QAPP) (11 August 2016)

Field logbook and page number where modification is documented (or attach associated correspondence):

Electronic mail dated 8 May 2017

Description of modification (attach additional sheets if necessary; include revised text for all document or SOP sections that are affected by the modification):

A field duplicate soil sample was not collected during the test pit investigation, as specified in the following sections of the FSP:

B.2.3 Field Quality Control Samples

Field QC samples associated with test pit investigation are field duplicates. These samples are discussed below.

One field duplicate sample will be collected in the Investigation Area. Soil field duplicate aliquots will be collected immediately adjacent to the parent aliquot sample locations. Therefore, the field duplicate will reflect the representativeness of the sampling approach. There is currently no acceptance criteria established for soil field duplicates. Field duplicate sample results may be used preferentially to the field sample results (for the same area) for decision making. Additionally, laboratory QC sample results may also be used preferentially to the field sample results for decision making.

Implication(s) of modification (if applicable, attach a list of affected property addresses or sample IDs):

This modification affects quality assurance/quality control (QA/QC) evaluation process for the two samples collected during the Test Pit Investigation since a comparison of parent/duplicate soil sample results will not be possible. However, the impacts to QA/QC evaluations are minimal since there are not current acceptance criteria established for soil field duplicates. This modification will not impact data results or the decision making process.

Duration of modification (indicate one):

Temporary Date(s): 20 April 2017

Permanent Effective Date: _____

Data Quality Indicator (indicate one; reference the definitions below for direction on selecting data quality indicators):

❑ Not Applicable ❑ Low Bias ❑ High Bias

☐ Reject ☐ Estimate ■ No Bias

Prepared by: _____ Date: 8 May 2016

Print Name: Scott Carney
(Team Leader or designate)

Approved by: _____ Date: 5/9/17

Print Name: Dania Zinner

(EPA RPM or designate)

DATA QUALITY INDICATOR DEFINITIONS

Reject - Samples associated with this modification form are not useable. The conditions outlined in the modification form adversely affect the associated sample to such a degree that the data are not reliable.

Low Bias - Samples associated with this modification form are useable, but results are likely to be biased low. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated low.

Estimate - Samples associated with this modification form are useable, but results should be considered approximations. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimates.

High Bias - Samples associated with this modification form are useable, but results are likely to be biased high. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated high.

No Bias - Samples associated with this modification form are useable as reported. The conditions outlined in the modification form suggest that associated sample data are reliable as reported.

Attachment D

PLM-VE Soil Sample Laboratory Report

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-VE

Prepared For: Don Goodrich, USEPA Region 8
Address: 1595 Wynkoop Street, Mail Stop 8EPR-PS, Denver, CO 80202

Laboratory Name: TechLaw, Inc. ESAT Region 8
Address: 16194 West 45th Drive, Golden, CO 80403

Report Authorization: 5-2-2017
Scott Walker, ESAT Region 8 Senior Analytical Chemist — Date

Standard Laboratory Data Package Checklist

Instructions: **Complete the following checklist and attach supporting documentation as outlined below.**

1	Laboratory Job No.:	A170060
2	Chain of Custody No.:	17-1009_FG
3	Date of sample receipt:	4/25/2017
4	Number of samples received:	5
5	Analytical Method:	PLM-VE
6	Method/SOP:	SRC-LIBBY-03 (REV 3)
7	SAP Analytical Summary No.:	OU6BG0816 (REV 2)
8	Test Report Correction No.:	C0
9	Condition of samples:	Acceptable
10	Technical Direction Form No.:	A150
11	Attachments:	

Chain of Custody form(s)
Case Narrative and any modification forms
Statement of Uncertainty
Analysis Results
Analytical Bench Sheet(s)

Report Verification: The quality control (QC) review signifies that all laboratory QC tasks were performed for the samples in this Laboratory Job Number, that this Analytical Test Report is accurate and complete, and that procedures fall within the required specifications.

Data Entry By (Initials and Date) JB 05/02/17

QC Review By (Initials and Date) LB 05/02/17

A170060

~~A170059~~ EO 4/25/17

Send To:
Lab: ESATR8
Lab Address: 16194 W. 45th Drive
Lab_Address2: Golden, CO 80403

From: ESAT Region 8/TechLaw _ CHAIN OF CUSTODY
TroyPrepLabLibby-MT
NoSamples: 5
RevisionNo

No: 17-1009_FG
Lab Contact: Landon Bailey
Lab Phone: (303) 312-7054
DateShipped: 4/24/2017

Lab #	Sample #	Tag	Collected	Analyses	Matrix	COCTurnaround	COCTurnaroundUnits
	BG-00332	FG4	4/20/2017	PLM-VE	Soil	10	Days
	BG-00333	FG1	4/20/2017	PLM-VE	Soil	10	Days
	BG-00334	FG3	4/21/2017	PLM-VE	Soil	10	Days
	BG-00335	FG2	4/24/2017	PLM-VE	Soil	10	Days
	BG-00336	FG4	4/24/2017	PLM-VE	Soil	10	Days

Special Instructions: SAP Analytical Summary # OU6BG0816 - Rev 2

SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
5	Andrea Wandler ESATR8-Troy	04/24/17 1014	Landon Bailey ESATR8	10:30 04/25/17	Acceptable

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-VE

CASE NARRATIVE

The TechLaw, Inc. ESAT Region 8 laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for bulk asbestos analysis by Polarized Light Microscopy (PLM) and is currently proficient in the NVLAP Bulk Asbestos Proficiency Testing program. The laboratory NVLAP Laboratory Identification Code is 200792-0.

NVLAP policy requires that this report may not be used by the client to claim product endorsement by NVLAP, National Institute of Standards and Technology (NIST), or any agency of the United States Government. This test report shall not be reproduced except in full, without written approval of the laboratory. This test report relates only to items tested.

The laboratory's Quality Assurance (QA) program requires that a minimum of 10% of all analyzed client samples be re-analyzed and logged into an internal QC tracking system. The results of these QC analyses for this Laboratory Job Number are provided in this Analytical Test Report as "LDC" (lab duplicate cross-check), "LDCR" (lab duplicate cross-check reprep) or "LDS" (lab duplicate self-check).

The following sections describe the analytical method used as indicated on Page 1, Line 5 of this report:

PLM-VE:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," with additional preparation and methodology for soil samples according to SRC-LIBBY-03, Revision 3, "Analysis of Asbestos Fibers in Fine Soil by Polarized Light Microscopy" and all current applicable Libby Lab Modification forms as specified in the relevant Sampling and Analysis Plan (SAP) Analytical Summary Sheet.

PLM-Grav:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," with additional preparation and methodology for soil samples according to SRC-LIBBY-01, Revision 3, "Qualitative Estimation of Asbestos in Coarse Soil by Visual Examination Using Stereomicroscopy and Polarized Light Microscopy" and all current applicable Libby Lab Modification forms as specified in the relevant SAP Analytical Summary Sheet.

PLM-PC400:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," according to ESAT Region 8 SOP PLM-01.01, "Bulk Asbestos Analysis by Polarized Light Microscopy," with the following modification: the Libby Amphibole suite of minerals are included in the tremolite-actinolite results.

PLM-600:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," according to ESAT Region 8 SOP PLM-01.01, "Bulk Asbestos Analysis by Polarized Light Microscopy."

Sample descriptions provided on the results spreadsheet may include both the client description (as listed on the COC) and the laboratory's description observed during stereomicroscopic examination when the two are different. The client description is listed first, then the laboratory's description is listed in brackets. For example, the COC may list "Floor tile" and the laboratory observes a green floor tile; the results will list "Floor tile [green]".

Additional Comments:

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-VE
ESAT Region 8 PLM Laboratory Statement of Uncertainty

The primary factor that contributes to random uncertainty of a PLM-600, PLM-VE and PLM-Grav analytical measurement is determined by the repeatability of an analysis. PLM-Grav analyses have additional uncertainty in a measurement due to the analytical balance which was calculated by the manufacturer as 0.1mg or 0.0001g. The following factors were identified to contribute to systematic uncertainty: sub-sampling of soils during preparation, variation in slide loading between analysts, interferences such as particles with similar optical properties as asbestos, ambiguity in the methods, and differences in analyst interpretation. Uncertainty contributed by field sampling conditions, soil grinding during the sample preparation at the Troy SPF, and shipment of samples is outside the laboratory's control and will not be evaluated by ESAT.

At the inception of the Libby Asbestos Superfund Site (referred to as the Libby Site), the EPA drafted reporting ranges called Bin Categories to further characterize the detection and quantification of asbestos at or below 1%. The majority of samples analyzed by ESAT are Non Detect (ND) or Trace (TR) as defined in site-specific SOP SRC-LIBBY-03 (current revision). With samples containing such a small quantity of asbestos, and the subjective nature of the PLM analytical method, uncertainty is virtually non-quantifiable in traditional statistical methodology. Therefore, zeros in the Quantitative Error table below are indicative of an analyst's reported result within one bin category difference of the original analytical results.

In addition to the quantitative error for client soil samples (stated below), analyst and laboratory accuracy, precision, and bias are determined from monthly reference slides, client samples, Round Robin samples, and NVLAP PE samples per NVLAP requirements (NIST Handbook 150-3 section 5.6 and 5.8) to maintain proficiency with bulk asbestos samples and standards.

Data Tables:

Quantitative Error (calculated using annual data from client QC samples in 2016)

Analyst Initials:	DK	NT	ND	JB	LB	FL	EO
Client QCs Analyzed	16	27	21	181	205	21	136
Client QC Error	0%	0%	4.8%	0%	0%	0%	0.7%

The data within the above table represents annual data from January - December 2016. Monthly updates to this table can be found in the monthly PLM QC Summary.

Qualitative Error (expressed as a percent of the total number of QC analyses for the ESAT Laboratory)

Total percentage of qualitative errors for the 2016 calendar year:	0.7%
Cumulative qualitative error rate from September 2007 - December 2016:	0.095%

Calculations:

Weight Percent

$$W_a = \frac{P_a * V_a * 100}{(100 - V_a) * P_m + (V_a * P_a)}$$

W_a = Weight % of a particular asbestos type
V_a = Volume % of asbestos
P_a = Density of Asbestos
P_m = Density of Matrix

Gravimetric Weight Percent

$$C_{\%} = \left(\frac{|W_a - W_s|}{W_s}\right) * 100$$

$C_{\%}$ = % concentration of a particular asbestos type
W_a = Overall weight of Sample
W_s =Weight of asbestos removed from sample

References:

Stewart, I. U. S. Department of the Interior, Environmental Protection Agency. (1988) Asbestos Content in Bulk Insulation Samples: Visual Estimates and Weight Composition . Washington D. C. : Office of Pesticides and Toxic Substances. EPA/560/5-88/011.

Taylor, J. (1997). *An introduction to error analysis: The study of uncertainties in physical measurements* (2nd ed.). Sausalito, Calif.: University Science Books.

Verkouteren, J. U. S. Department of Commerce, National Institute of Standards and Technology. (1997) Guide for Quality Control on the Qualitative and Quantitative Analysis of Bulk Asbestos Samples: Volume 1 . Galthersburg, MD: NISTR 5951.

PLM-VE Analysis Results

Laboratory Name: ESATR8 **Job Number:** A170060 **Date Received:** 04/25/2017 **SOP Name/Method:** SRC-LIBBY-03 (REV 3)

Client Sample Number	Tag	Lab Sample ID	QC Type	Date Analyzed	Analyst Name	Deviation	Sample Color Type/Texture	Homogeneous	Libby Amphibole (LA)			Other Amphibole (OA)			Chrysotile (CH)	
									Qual	CONC %	Bin	Qual	CONC %	Type	Qual	CONC %
BG-00332	FG4	A170060-01	NOT QC	05/01/2017	J. Bernard	No	Tan soil, fine	Yes	ND		A	ND			ND	
BG-00333	FG1	A170060-02	NOT QC	05/02/2017	J. Bernard	No	Tan soil, fine	Yes	ND		A	ND			ND	
BG-00334	FG3	A170060-03	NOT QC	05/02/2017	J. Bernard	No	Tan sand, fine	Yes	ND		A	ND			ND	
BG-00335	FG2	A170060-04	NOT QC	05/02/2017	J. Bernard	No	Tan sand, fine	Yes	ND		A	ND			ND	
BG-00336	FG4	A170060-05	NOT QC	05/02/2017	J. Bernard	No	Tan soil, fine	Yes	ND		A	ND			ND	

Client Sample Number	Tag	Lab Sample ID	QC Type	Habit	Fiber Color	Sign of Elongation	Pleochroism	Extinction Angle	Ref. Index α	Ref. Index γ	Birefringence	Analysis Status	Analysis Comments
BG-00332	FG4	A170060-01	NOT QC									Analyzed	
BG-00333	FG1	A170060-02	NOT QC									Analyzed	
BG-00334	FG3	A170060-03	NOT QC									Analyzed	
BG-00335	FG2	A170060-04	NOT QC									Analyzed	
BG-00336	FG4	A170060-05	NOT QC									Analyzed	

Laboratory Name: ESATR8
Work Order No.: A170060
Method/SOP: SRC-LIBBY-03 (REV 3)

LIBBY ASBESTOS SUPERFUND SITE
ANALYSIS BENCH SHEET (PLM-VE)

Doc. No.: TLF-23.03
Effective Date: 04/15/15

(Circled entries shown in bold.)

Client Sample No.	Tag	Lab Sample ID	QC Type	Date Analyzed	Analyst Initials	Deviation	Sample Color [1]	STEREOMICROSCOPIC EXAMINATION: Sample Type/Texture	Homogeneity	Est. % LA	Est. % Other Asbestos	ASBESTOS MINERALS OBSERVED: LA-Qual	LA-%	OA-Qual	OA-AF %	OA Type	CH-Qual	CH-AF %	ASBESTOS OPTICAL PROPERTIES: Habit [2]	Fiber Color [1]	Sign of Elongation	Pleochroism	Extinction Angle [3]	Ref. Index (α)	Ref. Index (γ)	Birefringence [4]	RI Determined By [5]	Temperature (°C)	OTHER: Type and % of Non-Asbestos Fibers (w/ optical properties [6])	Non-Fibrous Matrix Materials (if known) [7]	Comments [8]
[1] BL = Blue, BR = Brown, C = Colorless, G = Gray, GR = Green, R = Red, T = Tan, V = Violet, Y = Yellow; [2] AF= Asbestiform, NAF= Non-Asbestiform; [3] I = Inclined, P = Parallel; [4] L = Low, M = Moderate, H = High; [5] BL = Becke Lines, DS = Dispersion Staining; [6] B = High Birefringence, H = Habit, I = Isotropic, O = Opaque, P = Parallel Extinction, RI = Refractive Index, S = Sign of Elongation, U = Undulatory Extinction; [7] A = Amphibole, C = Cellulose, F = Feldspar, M = Mica, O = Opaques, Q = Quartz; [8] 1 = LA grain has striations, 2 = Some fibers length fast, 3 = Not analyzed per client request, 4 = PLM-1, 5 = PLM-2																															
BG-00332	FG4	A170060-01	**NOT QC** LDC LDCR LDS	05/01/17	JB	Yes **No**	T	**Soil** Sand **Fine** Coarse	**Yes** No	**ND** TR	**ND** TR	**ND** TR < DET		**ND** < DET		AMOS CROC ANTH	**ND** < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		Tr CELL H FBGL OTHR SYN	A C F M **O** **Q**	1 2 3 **4** 5
BG-00333	FG1	A170060-02	**NOT QC** LDC LDCR LDS	05/02/17	JB	Yes **No**	T	**Soil** Sand **Fine** Coarse	**Yes** No	**ND** TR	**ND** TR	**ND** TR < DET		**ND** < DET		AMOS CROC ANTH	**ND** < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		Tr CELL H FBGL OTHR SYN	A C F M **O** **Q**	1 2 3 **4** 5
BG-00334	FG3	A170060-03	**NOT QC** LDC LDCR LDS	05/02/17	JB	Yes **No**	T	Soil **Sand** **Fine** Coarse	**Yes** No	**ND** TR	**ND** TR	**ND** TR < DET		**ND** < DET		AMOS CROC ANTH	**ND** < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		~~CELL FBGL OTHR SYN~~	A C F M **O** **Q**	1 2 3 **4** 5
BG-00335	FG2	A170060-04	**NOT QC** LDC LDCR LDS	05/02/17	JB	Yes **No**	T	Soil **Sand** **Fine** Coarse	**Yes** No	**ND** TR	**ND** TR	**ND** TR < DET		**ND** < DET		AMOS CROC ANTH	**ND** < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		~~CELL FBGL OTHR SYN~~	A C F M **O** **Q**	1 2 3 **4** 5
BG-00338	FG4	A170060-05	**NOT QC** LDC LDCR LDS	05/02/17	JB	Yes **No**	T	**Soil** Sand **Fine** Coarse	**Yes** No	**ND** TR	**ND** TR	**ND** TR < DET		**ND** < DET		AMOS CROC ANTH	**ND** < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		Tr CELL H FBGL OTHR SYN	A C F M **O** **Q**	1 2 3 **4** 5
			NOT QC LDC LDCR LDS			Yes No		Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
			NOT QC LDC LDCR LDS			Yes No		Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
			NOT QC LDC LDCR LDS			Yes No		Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
			NOT QC LDC LDCR LDS			Yes No		Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
			NOT QC LDC LDCR LDS			Yes No		Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5

Page 1 of 1

Attachment E

PLM-Grav Soil Sample Laboratory Report

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-Grav

Prepared For: Don Goodrich, USEPA Region 8
Address: 1595 Wynkoop Street, Mail Stop 8EPR-PS, Denver, CO 80202

Laboratory Name: TechLaw, Inc. ESAT Region 8
Address: 16194 West 45th Drive, Golden, CO 80403

Report Authorization: Scott Walker, ESAT Region 8 Senior Analytical Chemist — Date: 5-1-2017

Standard Laboratory Data Package Checklist

Instructions: **Complete the following checklist and attach supporting documentation as outlined below.**

1	Laboratory Job No.:	A170059
2	Chain of Custody No.:	17-1009_C
3	Date of sample receipt:	4/25/2017
4	Number of samples received:	2
5	Analytical Method:	PLM-Grav
6	Method/SOP:	SRC-LIBBY-01 (REV 3)
7	SAP Analytical Summary No.:	OU6BG0816 (REV 2)
8	Test Report Correction No.:	C0
9	Condition of samples:	Acceptable
10	Technical Direction Form No.:	A150
11	Attachments:	

Chain of Custody form(s)
Case Narrative and any modification forms
Statement of Uncertainty
Analysis Results
Analytical Bench Sheet(s)

Report Verification: The quality control (QC) review signifies that all laboratory QC tasks were performed for the samples in this Laboratory Job Number, that this Analytical Test Report is accurate and complete, and that procedures fall within the required specifications.

Data Entry By (Initials and Date) EO 5/1/17

QC Review By (Initials and Date) LB 05/01/17

A170059

EO 4/25/17 ~~A170060~~

Send To:
Lab: ESATR8
Lab Address: 16194 W. 45th Drive
Lab_Address2: Golden, CO 80403

From: ESAT Region 8/TechLaw _ CHAIN OF CUSTODY
TroyPrepLabLibby-MT
NoSamples: 2
RevisionNo

No: 17-1009_C
Lab Contact: Landon Bailey
Lab Phone: (303) 312-7054
DateShipped: 4/24/2017

Lab #	Sample #	Tag	Collected	Analyses	Matrix	COCTurnaround	COCTurnaroundUnits
	BG-00332	C2	4/20/2017	PLM-Grav	Soil	10	Days
	BG-00336	C3	4/24/2017	PLM-Grav	Soil	10	Days

Special Instructions: SAP Analytical Summary # OU6BG0816 - Rev 2

SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
2	Andrea Wandler ESATR8-Troy	04/24/17 10:45	Landon Bailey ESATR8	04/25/17 10:30	Acceptable

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-Grav

CASE NARRATIVE

The TechLaw, Inc. ESAT Region 8 laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for bulk asbestos analysis by Polarized Light Microscopy (PLM) and is currently proficient in the NVLAP Bulk Asbestos Proficiency Testing program. The laboratory NVLAP Laboratory Identification Code is 200792-0.

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The laboratory's Quality Assurance (QA) program requires that a minimum of 10% of all analyzed client samples be re-analyzed and logged into an internal QC tracking system. The results of these QC analyses for this Laboratory Job Number are provided in this Analytical Test Report as "LDC" (lab duplicate cross-check), "LDCR" (lab duplicate cross-check reprep) or "LDS" (lab duplicate self-check).

The following sections describe the analytical method used as indicated on Page 1, Line 5 of this report:

PLM-VE:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," with additional preparation and methodology for soil samples according to SRC-LIBBY-03, Revision 3, "Analysis of Asbestos Fibers in Fine Soil by Polarized Light Microscopy" and all current applicable Libby Lab Modification forms as specified in the relevant Sampling and Analysis Plan (SAP) Analytical Summary Sheet.

PLM-Grav:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," with additional preparation and methodology for soil samples according to SRC-LIBBY-01, Revision 3, "Qualitative Estimation of Asbestos in Coarse Soil by Visual Examination Using Stereomicroscopy and Polarized Light Microscopy" and all current applicable Libby Lab Modification forms as specified in the relevant SAP Analytical Summary Sheet.

PLM-PC400:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," according to ESAT Region 8 SOP PLM-01.01, "Bulk Asbestos Analysis by Polarized Light Microscopy," with the following modification: the Libby Amphibole suite of minerals are included in the tremolite-actinolite results.

PLM-600:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," according to ESAT Region 8 SOP PLM-01.01, "Bulk Asbestos Analysis by Polarized Light Microscopy."

Sample descriptions provided on the results spreadsheet may include both the client description (as listed on the COC) and the laboratory's description observed during stereomicroscopic examination when the two are different. The client description is listed first, then the laboratory's description is listed in brackets. For example, the COC may list "Floor tile" and the laboratory observes a green floor tile; the results will list "Floor tile [green]".

Additional Comments:

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-Grav
ESAT Region 8 PLM Laboratory Statement of Uncertainty

The primary factor that contributes to random uncertainty of a PLM-600, PLM-VE and PLM-Grav analytical measurement is determined by the repeatability of an analysis. PLM-Grav analyses have additional uncertainty in a measurement due to the analytical balance which was calculated by the manufacturer as 0.1mg or 0.0001g. The following factors were identified to contribute to systematic uncertainty: sub-sampling of soils during preparation, variation in slide loading between analysts, interferences such as particles with similar optical properties as asbestos, ambiguity in the methods, and differences in analyst interpretation. Uncertainty contributed by field sampling conditions, soil grinding during the sample preparation at the Troy SPF, and shipment of samples is outside the laboratory's control and will not be evaluated by ESAT.

At the inception of the Libby Asbestos Superfund Site (referred to as the Libby Site), the EPA drafted reporting ranges called Bin Categories to further characterize the detection and quantification of asbestos at or below 1%. The majority of samples analyzed by ESAT are Non Detect (ND) or Trace (TR) as defined in site-specific SOP SRC-LIBBY-03 (current revision). With samples containing such a small quantity of asbestos, and the subjective nature of the PLM analytical method, uncertainty is virtually non-quantifiable in traditional statistical methodology. Therefore, zeros in the Quantitative Error table below are indicative of an analyst's reported result within one bin category difference of the original analytical results.

In addition to the quantitative error for client soil samples (stated below), analyst and laboratory accuracy, precision, and bias are determined from monthly reference slides, client samples, Round Robin samples, and NVLAP PE samples per NVLAP requirements (NIST Handbook 150-3 section 5.6 and 5.8) to maintain proficiency with bulk asbestos samples and standards.

Data Tables:

Quantitative Error (calculated using annual data from client QC samples in 2016)

Analyst Initials:	DK	NT	ND	JB	LB	FL	EO
Client QCs Analyzed	16	27	21	181	205	21	136
Client QC Error	0%	0%	4.8%	0%	0%	0%	0.7%

The data within the above table represents annual data from January - December 2016. Monthly updates to this table can be found in the monthly PLM QC Summary.

Qualitative Error (expressed as a percent of the total number of QC analyses for the ESAT Laboratory)

Total percentage of qualitative errors for the 2016 calendar year:	0.7%
Cumulative qualitative error rate from September 2007 - December 2016:	0.095%

Calculations:

Weight Percent

$$W_a = \frac{P_a * V_a * 100}{(100 - V_a) * P_m + (V_a * P_a)}$$

W_a = Weight % of a particular asbestos type
V_a = Volume % of asbestos
P_a = Density of Asbestos
P_m = Density of Matrix

Gravimetric Weight Percent

$$C_{\%} = \left(\frac{|W_a - W_s|}{W_s}\right) * 100$$

$C_{\%}$ = % concentration of a particular asbestos type
W_a = Overall weight of Sample
W_s =Weight of asbestos removed from sample

References:

Stewart, I. U. S. Department of the Interior, Environmental Protection Agency. (1988) Asbestos Content in Bulk Insulation Samples: Visual Estimates and Weight Composition . Washington D. C. : Office of Pesticides and Toxic Substances. EPA/560/5-88/011.

Taylor, J. (1997). *An introduction to error analysis: The study of uncertainties in physical measurements* (2nd ed.). Sausalito, Calif.: University Science Books.

Verkouteren, J. U. S. Department of Commerce, National Institute of Standards and Technology. (1997) Guide for Quality Control on the Qualitative and Quantitative Analysis of Bulk Asbestos Samples: Volume 1 . Galthersburg, MD: NISTR 5951.

PLM-Grav Analysis Results

Laboratory Name: ESATR8 **Job Number:** A170059 **Date Received:** 04/25/2017 **SOP Name/Method:** SRC-LIBBY-01 (REV 3)

Client Sample Number	Tag	Lab Sample ID	QC Type	Date Analyzed	Analyst Name	Deviation	Homogeneous	Sample Weight (g)	Libby Amphibole (LA)			Other Amphibole (OA)				Chrysotile (CH)			Analysis Status	Analysis Comments
									Qual	Weight (g)	CONC %	Qual	Type	Weight (g)	CONC %	Qual	Weight (g)	CONC %		
BG-00332	C2	A170059-01	NOT QC	04/28/2017	E. Orthun	No	Yes	17.6826	ND			ND				ND			Analyzed	Coarse and fine material observed
BG-00336	C3	A170059-02	NOT QC	04/28/2017	E. Orthun	No	Yes	10.2685	ND			ND				ND			Analyzed	Coarse and fine material observed

Laboratory Name: ESATR8
Work Order No.: A170059
Method/SOP: SRC-LIBBY-01 (REV 3)

LIBBY ASBESTOS SUPERFUND SITE
ANALYSIS BENCH SHEET (PLM-Grav)

Doc. No.: TLF-24.04
Effective Date: 04/22/15

Client Sample No.	Tag	Lab Sample ID	QC Type	Date Analyzed	Analyst Initials	Deviation	SAMPLE MASS (g): Wt of Empty Container	SAMPLE MASS (g): Wt of Sample + Container	STEREOMICROSCOPIC EXAMINATION: Sample Color [1]	Sample Type/Texture	Homogeneity	Type and % Non-Asbestos Fibers	Non-Fibrous Matrix Materials (if known) [2]	MASS OF ASBESTOS PARTICLES (g): LA-Qual	Wt of Empty Container	Wt of LA + Container	OA-Qual	OA Type	Wt of Empty Container	Wt of OA + Container	CH-Qual	Wt of Empty Container	Wt of CH + Container	ASBESTOS OPTICAL PROPERTIES BY PLM: Habit [3]	Fiber Color [1]	Sign of Elongation	Pleochroism	Extinction Angle [4]	Ref. Index (α)	Ref. Index (γ)	Birefringence [5]	RI Determined By [6]	Temperature (°C)	Comments [7]
BG-00332	C2	A170059-01	**NOT QC** LDC LDS	4/28/17	ED	Yes **No**	1.2984	18.9810	T	**Soil** Sand Fine **Coarse**	**Yes** No	___ CELL ___ FBGL ___ OTHR ___ SYN	**R** **S**	**ND** TR DET			**ND** TR DET	AMOS CROC ANTH			**ND** TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		**1** 2 3 **4**
BG-00336	C3	A170059-02	**NOT QC** LDC LDS	4/28/17	ED	Yes **No**	1.2953	11.5638	T	**Soil** Sand Fine **Coarse**	**Yes** No	___ CELL ___ FBGL ___ OTHR ___ SYN	**R** **S**	**ND** TR DET			**ND** TR DET	AMOS CROC ANTH			**ND** TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		**1** 2 3 **4**
			NOT QC LDC LDS			Yes No				Soil Send Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Send Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4

[1] BL = Blue, BR = Brown, C = Colorless, G = Gray, GR = Green, R = Red, T = Tan, V = Violet, Y = Yellow; [2] R = Rocks, S = Soil; [3] AF= Asbestiform, NAF=Non-Asbestiform; [4] I = Inclined, P = Parallel; [5] L = Low, M = Moderate, H = High; [6] BL = Becke Lines, DS = Dispersion Staining; [7] 1 = Coarse and fine material observed, 2 = PLM-1, 3 = PLM-2, 4 = Balance-1

Attachment F

PLM Data Validation Checklists

Data Review Checklist for the Validation of Libby Polarized Light Microscopy (PLM) Data Deliverables

Project Name: BNSF- Libby	**Laboratory Job No:** A170059
Number of Samples/Matrix: 2/ Soil	**Laboratory:** TechLaw, Inc. ESAT Region 8
PLM Method/SOP: SRC-LIBBY-01 (REV 3)	**SAP Number:** OU6BG0816 (REV 2)
Laboratory Modifications:	

1.0 Data Package Inventory	Yes	No	Comments
1.1 Were the project-specific requirements provided in the SAP Analytical Summary submitted with the data package?	☒	☐	
1.2 Did the received hard copy deliverables contain all the necessary components:			
1.2.1 Narrative?	☒	☐	
1.2.2 Chain-of-Custody?	☒	☐	
1.2.3 EDD Files?	☒	☐	
1.2.4 Raw Data – Bench Sheets?	☒	☐	
1.2.5 QC Sample Data:			
1.2.5.1 Contamination Check(s)?	☒	☐	Based on analysis date of 4/28/17 and cross check with Daily Contamination Check
1.2.5.2 Laboratory Duplicate Cross-Check (LDC)?	☐	☒	
1.2.5.3 Laboratory Duplicate Self-Check (LDS)?	☐	☒	
1.2.6 Calibration Data (submitted quarterly)?	☒	☐	
1.2.7 Communication Records?	☐	☒	
1.2.8 Miscellaneous?	☒	☐	See Additional Comments below
2.0 Chain-of-Custody Information			
2.1 Was the following information recorded in the hard copy electronic deliverables (if applicable) and is it consistent with the information recorded on the COC:			
2.1.1 COC Number?	☒	☐	
2.1.2 Case or Sample Set Number?	☒	☐	
2.1.3 EPA Sample ID?	☒	☐	
2.1.4 Date/Time Collected?	☐	☒	Date included but no time
2.1.5 Sample Matrix?	☒	☐	
2.1.6 Analyses (Method)?	☒	☐	PLM-Grav
2.1.7 Date/Time Received?	☒	☐	
2.1.8 Other (describe)?	☒	☐	Tag, COC turnaround days
2.2 Were the COC records signed and dated upon receipt?	☒	☐	

Additional Comments:

Lab Provided:

-SOP for Validation of Libby PLM Data Deliverables (June 24, 2013)
-Test Methods [SRC-LIBBY-01 Rev 3 (September 19, 2012) and SRC-LIBBY-03 Rev 3 (July 27, 2012)]
-Lab Calibration Information (various dates), including:
  -Daily Contamination Check
  -PLM-1 Alignment Check
  -PLM-2 Alignment Check
  -Refractive Index Liquid Contamination Check Log
  -Refractive Index Liquid Calibration Log
  -PLM Laboratory Air Monitoring
  -Air Pump Calibration
  -Analytical Balance Calibration
-SOP for Soil Sample Preparation at Troy Prep Lab (January 16, 2015)
-EDD Excel file of Troy Prep Lab's log for the samples

Data Review Checklist for the Validation of Libby Polarized Light Microscopy (PLM) Data Deliverables

3.0 Sample Result Validation	Yes	No	Comments
3.1 Prior to analysis by PLM, are samples examined at low magnification using a stereoscope?	☒	☐	
3.1.1 Are the following observations recorded for each sample:			
3.1.1.1 Color?	☒	☐	
3.1.1.2 Texture?	☒	☐	
3.1.1.3 Homogeneity?	☒	☐	
3.1.1.4 Percent (%) fibrous material or Bin?	☐	☒	Section is crossed off in bench sheet
3.2 Is the technique used to prepare samples to slides recorded (i.e. particle size reduction, acid treatment, heating, melting or teasing)?	☒	☐	
3.3 Was gravimetric analysis performed?	☐	☐	Asbestos Not Detected
3.3.1 If yes, were the necessary sample weights and tare weights recorded and provided?	☐	☐	
Using the recorded weights, recalculate a minimum of 10% of the samples for which gravimetric analysis was performed.			
3.3.1.1 Are the recalculated concentrations consistent with those reported?	☐	☐	
3.4 Is qualitative identification of fibrous materials performed by examining fiber morphology and observance of optical properties?	☐	☒	No Data for Asbestos Particles
3.4.1 Are the following recorded for all reported fibrous materials:			
3.4.1.1 Morphology?	☐	☐	
3.4.1.2 Color?	☐	☐	
3.4.1.3 Refractive Indices?	☐	☐	
3.4.1.4 Sign of Elongation?	☐	☐	
3.4.1.5 Extinction Angle?	☐	☐	
3.4.1.6 Pleochroism?	☐	☐	
3.4.1.7 Birefringence?	☐	☐	
3.4.1.8 Dispersion staining characteristics?	☐	☐	
3.5 Do the recorded morphology and optical properties in the raw data agree with the type of fibrous material(s) reported?	☐	☐	

Additional Comments:

Data Review Checklist for the Validation of Libby Polarized Light Microscopy (PLM) Data Deliverables

3.0 Sample Result Validation	Yes	No	Comments
3.6 Are LA results reported in the appropriate bin categories? **(PLM-VE only)**	☐	☐	Not Applicable
3.6.1 Non-detects recorded as Bin A?	☐	☐	
3.6.2 Less than 0.2% LA recorded as Bin B1?	☐	☐	
3.6.3 Greater than 0.2%, but less than 1% recorded as Bin B2?	☐	☐	
3.6.4 Equal to or greater than 1% recorded as Bin C, with the percentage recorded as a whole number?	☐	☐	

4.0 Quality Control Validation	Yes	No	Comments
4.1 Contamination Checks			
4.1.1 Are laboratory contamination blanks prepared and analyzed at the required frequency?	☒	☐	Prepared and analyzed on a daily basis
4.1.2 Are contamination check results within the specified criteria?	☒	☐	Asbestos fibers must not be detected in contamination checks; contamination check identifies no corrective action required on 4/28/17
4.1.2.1 If "no" then qualify the associated results in accordance with the Contamination Check Analysis table in SOP QATS-70-094.			
4.2 Laboratory Duplicate Cross-Check (LDC) Analyses			
4.2.1 Are LDC (reanalyzed by a second analyst) sample analyses performed and reported with the sample set?	☐	☒	
4.3 Laboratory Duplicate Self-Check (LDS) Analyses			
4.3.1 Are LDS (reanalyzed by the same analyst) sample analyses performed and reported with the sample set?	☐	☒	
Note: LDC and LDS analyses are reviewed and evaluated on a program wide basis. Qualification is not applied during the validation process; however, the QC samples reported with the sample set are listed in the validation report.			

Additional Comments:

Data Review Checklist for the Validation of Libby Polarized Light Microscopy (PLM) Data Deliverables

4.0 Quality Control Validation	Yes	No	Comments
4.4 Reference Slide Analysis (if applicable)			Not Applicable
4.4.1 Are reference slide analyses provided by the laboratory?	☐	☐	
4.4.2 Are reference slide analyses performed at the required frequency?	☐	☐	
4.4.3 Are the reference slide analyses results within the specified acceptance criteria?	☐	☐	
4.4.3.1 If "no" then qualify the associated results in accordance with the Reference Material Analysis table in SOP QATS-70-094.			
5.0 Calibration & Microscope Alignment Validation			
5.1 Are evidence of microscope alignment and Refractive Index (RI) liquid calibration provided for all sample analyses?	☒	☐	No RI on 4/28/17, but there were also no refractive indices data collected for asbestos particles.
5.1.1 Microscope-specific alignment checks?	☒	☐	PLM-2 used on 4/28/17
5.1.2 Microscope-specific contamination checks?	☒	☐	PLM Hoods 2, 3 used on 4/28/17
5.1.3 Calibration RI liquids?	☐	☐	Not applicable
5.2 Are alignment and calibration checks listed above performed at the required frequencies?	☒	☐	Alignment checks performed daily RI liquid calibration prior to use and monthly
5.3 Are alignment and calibration checks within the specified criteria?	☒	☐	All alignment boxes checked for PLM-2 on 4/28/17; no RI liquid calibration necessary
5.4 Are all alignment and calibration checks traceable to the associated samples analyses?	☒	☐	Dates and analyst initials cross check
5.4.1 If "no" then qualify the associated results in accordance with the Microscope Alignment and RI Liquid Calibration tables in SOP QATS-70-094.			
6.0 Narrative Validation			
6.1 Does the data package narrative include descriptions of the following:			
6.1.1 Samples received (matrix/method)?	☒	☐	
6.1.2 Method/Laboratory Modifications?	☒	☐	
6.1.3 Example sample calculation?	☒	☐	
6.1.4 Laboratory blank contamination?	☐	☒	
6.1.5 Quality control analyses outside specified criteria?	☐	☒	
6.1.6 Any problems encountered and subsequent corrective action?	☐	☒	

Additional Comments:

Validated By Sheila Sahu **Date** 6/1/2017

QA Review [signature] **Date** 6-13-17

Data Review Checklist for the Validation of Libby Polarized Light Microscopy (PLM) Data Deliverables

Project Name: BNSF- Libby	**Laboratory Job No:** A170060
Number of Samples/Matrix: 5/ Soil	**Laboratory:** TechLaw, Inc. ESAT Region 8
PLM Method/SOP: SRC-LIBBY-03 (REV 3)	**SAP Number:** OU6BG0816 (REV 2)
Laboratory Modifications:	

1.0 Data Package Inventory	Yes	No	Comments
1.1 Were the project-specific requirements provided in the SAP Analytical Summary submitted with the data package?	☒	☐	
1.2 Did the received hard copy deliverables contain all the necessary components:			
1.2.1 Narrative?	☒	☐	
1.2.2 Chain-of-Custody?	☒	☐	
1.2.3 EDD Files?	☒	☐	
1.2.4 Raw Data – Bench Sheets?	☒	☐	
1.2.5 QC Sample Data:			
1.2.5.1 Contamination Check(s)?	☒	☐	Based on analysis date and cross check with Daily Contamination Check
1.2.5.2 Laboratory Duplicate Cross-Check (LDC)?	☐	☒	
1.2.5.3 Laboratory Duplicate Self-Check (LDS)?	☐	☒	
1.2.6 Calibration Data (submitted quarterly)?	☒	☐	
1.2.7 Communication Records?	☐	☒	
1.2.8 Miscellaneous?	☒	☐	See Additional Comments below
2.0 Chain-of-Custody Information			
2.1 Was the following information recorded in the hard copy electronic deliverables (if applicable) and is it consistent with the information recorded on the COC:			
2.1.1 COC Number?	☒	☐	
2.1.2 Case or Sample Set Number?	☒	☐	
2.1.3 EPA Sample ID?	☒	☐	
2.1.4 Date/Time Collected?	☐	☒	Date included but no time
2.1.5 Sample Matrix?	☒	☐	
2.1.6 Analyses (Method)?	☒	☐	PLM-VE
2.1.7 Date/Time Received?	☒	☐	
2.1.8 Other (describe)?	☒	☐	Tag, COC turnaround days
2.2 Were the COC records signed and dated upon receipt?	☒	☐	

Additional Comments:

Lab Provided:

-SOP for Validation of Libby PLM Data Deliverables (June 24, 2013)
-Test Methods [SRC-LIBBY-01 Rev 3 (September 19, 2012) and SRC-LIBBY-03 Rev 3 (July 27, 2012)]
-Lab Calibration Information (various dates), including:
  -Daily Contamination Check
  -PLM-1 Alignment Check
  -PLM-2 Alignment Check
  -Refractive Index Liquid Contamination Check Log
  -Refractive Index Liquid Calibration
  -PLM Labortory Air Monitoring
  -Air Pump Calibration
  -Analytical Balance Calibration
-SOP for Soil Sample Preparation at Troy Prep Lab (January 16, 2015)
-EDD Excel file of Troy Prep Lab's log for the samples

Data Review Checklist for the Validation of Libby Polarized Light Microscopy (PLM) Data Deliverables

3.0 Sample Result Validation	Yes	No	Comments
3.1 Prior to analysis by PLM, are samples examined at low magnification using a stereoscope?	☒	☐	
3.1.1 Are the following observations recorded for each sample:			
3.1.1.1 Color?	☒	☐	
3.1.1.2 Texture?	☒	☐	
3.1.1.3 Homogeneity?	☒	☐	
3.1.1.4 Percent (%) fibrous material or Bin?	☒	☐	Section is crossed off in bench sheet for 2 out of 5 samples (BG-00334 and BG-00335)
3.2 Is the technique used to prepare samples to slides recorded (i.e. particle size reduction, acid treatment, heating, melting or teasing)?	☒	☐	
3.3 Was gravimetric analysis performed?	☐	☐	Not Applicable
3.3.1 If yes, were the necessary sample weights and tare weights recorded and provided?	☐	☐	
Using the recorded weights, recalculate a minimum of 10% of the samples for which gravimetric analysis was performed.			
3.3.1.1 Are the recalculated concentrations consistent with those reported?	☐	☐	
3.4 Is qualitative identification of fibrous materials performed by examining fiber morphology and observance of optical properties?	☐	☒	. No Data for Asbestos Particles
3.4.1 Are the following recorded for all reported fibrous materials:			
3.4.1.1 Morphology?	☐	☐	
3.4.1.2 Color?	☐	☐	
3.4.1.3 Refractive Indices?	☐	☐	
3.4.1.4 Sign of Elongation?	☐	☐	
3.4.1.5 Extinction Angle?	☐	☐	
3.4.1.6 Pleochroism?	☐	☐	
3.4.1.7 Birefringence?	☐	☐	
3.4.1.8 Dispersion staining characteristics?	☐	☐	
3.5 Do the recorded morphology and optical properties in the raw data agree with the type of fibrous material(s) reported?	☐	☐	

Additional Comments:

Data Review Checklist for the Validation of Libby Polarized Light Microscopy (PLM) Data Deliverables

3.0 Sample Result Validation	Yes	No	Comments
3.6 Are LA results reported in the appropriate bin categories? **(PLM-VE only)**	☒	☐	
3.6.1 Non-detects recorded as Bin A?	☒	☐	
3.6.2 Less than 0.2% LA recorded as Bin B1?	☐	☐	Not Applicable
3.6.3 Greater than 0.2%, but less than 1% recorded as Bin B2?	☐	☐	Not Applicable
3.6.4 Equal to or greater than 1% recorded as Bin C, with the percentage recorded as a whole number?	☐	☐	Not Applicable

4.0 Quality Control Validation	Yes	No	Comments
4.1 Contamination Checks			
4.1.1 Are laboratory contamination blanks prepared and analyzed at the required frequency?	☒	☐	Prepared and analyzed on a daily basis
4.1.2 Are contamination check results within the specified criteria?	☒	☐	Asbestos fibers must not be detected in contamination checks; contamination check identifies no corrective action required for 5/1/17 and 5/2/17
4.1.2.1 If "no" then qualify the associated results in accordance with the Contamination Check Analysis table in SOP QATS-70-094.			
4.2 Laboratory Duplicate Cross-Check (LDC) Analyses			
4.2.1 Are LDC (reanalyzed by a second analyst) sample analyses performed and reported with the sample set?	☐	☒	
4.3 Laboratory Duplicate Self-Check (LDS) Analyses			
4.3.1 Are LDS (reanalyzed by the same analyst) sample analyses performed and reported with the sample set?	☐	☒	
Note: LDC and LDS analyses are reviewed and evaluated on a program wide basis. Qualification is not applied during the validation process; however, the QC samples reported with the sample set are listed in the validation report.			

Additional Comments:

Data Review Checklist for the Validation of Libby Polarized Light Microscopy (PLM) Data Deliverables

4.0 Quality Control Validation	Yes	No	Comments
4.4 Reference Slide Analysis (if applicable)			Not Applicable
4.4.1 Are reference slide analyses provided by the laboratory?	☐	☐	
4.4.2 Are reference slide analyses performed at the required frequency?	☐	☐	
4.4.3 Are the reference slide analyses results within the specified acceptance criteria?	☐	☐	
4.4.3.1 If "no" then qualify the associated results in accordance with the Reference Material Analysis table in SOP QATS-70-094.			
5.0 Calibration & Microscope Alignment Validation			
5.1 Are evidence of microscope alignment and Refractive Index (RI) liquid calibration provided for all sample analyses?	☒	☐	No RI on 05/1/17 or 5/2/17, but there were also no refractive indices data collected for asbestos particles.
5.1.1 Microscope-specific alignment checks?	☒	☐	PLM-1 used on 5/1/17 and 5/2/17
5.1.2 Microscope-specific contamination checks?	☒	☐	PLM Hood 1 used on 5/1/17 and 5/2/17
5.1.3 Calibration RI liquids?	☐	☐	Not Applicable
5.2 Are alignment and calibration checks listed above performed at the required frequencies?	☒	☐	Alignment checks performed daily RI liquid calibration prior to use and monthly
5.3 Are alignment and calibration checks within the specified criteria?	☒	☐	All alignment boxes checked for PLM-1 on 5/1/17 and 5/2/17; no RI liquid calibration necessary
5.4 Are all alignment and calibration checks traceable to the associated samples analyses?	☒	☐	Dates and analyst initials cross check
5.4.1 If "no" then qualify the associated results in accordance with the Microscope Alignment and RI Liquid Calibration tables in SOP QATS-70-094.			
6.0 Narrative Validation			
6.1 Does the data package narrative include descriptions of the following:			
6.1.1 Samples received (matrix/method)?	☒	☐	
6.1.2 Method/Laboratory Modifications?	☒	☐	
6.1.3 Example sample calculation?	☒	☐	
6.1.4 Laboratory blank contamination?	☐	☒	
6.1.5 Quality control analyses outside specified criteria?	☐	☒	
6.1.6 Any problems encountered and subsequent corrective action?	☐	☒	

Additional Comments:

Validated By Sheila Sahu **Date** 6/1/2017

QA Review [signature] **Date** 6-13-17

Attachment G

Routine QC Laboratory Reports

TechLaw, Inc.
ESAT Region 8
16194 W. 45th Drive
Golden, CO 80403

Daily Contamination Check for PLM Laboratory Hoods (B-130)

Logbook #R8-LB-PLM-037

Start Date: 02/05/2016

Date	Hood ID	RI Liquid Set	RI Liquid Used	Sample Type(s) Prepared	Asbestos-Free Material Used	Total	Asbestos Type	Corrective Action Required	PLM ID	Analyst Initials	Comments
03/29/17	Hood-1	Set 1	1.640	PE	Fiberglass	0	N/A	No	PLM-2	DK	
03/29/17	Hood-2	Set 1	1.640	PE	Fiberglass	0	N/A	No	PLM-2	DK	
04/05/17	Hood-3	Set 2	1.620	PE	Fiberglass	0	N/A	No	PLM-2	EO	
04/07/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-1	JB	
04/10/17	Hood-2	Set 2	1.620	PE	Fiberglass	0	N/A	No	PLM-1	DK	
04/10/17	Hood-1	Set 1	1.620	9002B	Fiberglass	0	N/A	No	PLM-1	JB	
04/10/17	Hood-3	Set 2	1.620	Grav	Fiberglass	0	N/A	No	PLM-2	EO	
04/10/17	Hood-2	Set 2	1.620	VE, Grav	Fiberglass	0	N/A	No	PLM-2	EO	
04/11/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-1	JB	
04/11/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-2	EO	
04/12/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-2	EO	
04/12/17	Hood-1	Set 1	1.620	VE, Grav	Fiberglass	0	N/A	No	PLM-1	JB	
04/12/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-1	JB	
04/13/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-1	JB	
04/13/17	Hood-3	Set 2	1.620	Grav	Fiberglass	0	N/A	No	PLM-1	EO	
04/13/17	Hood-2	Set 2	1.620	VE, Grav	Fiberglass	0	N/A	No	PLM-1	EO	
04/17/17	Hood-3	Set 2	1.620	Grav	Fiberglass	0	N/A	No	PLM-2	EO	
04/17/17	Hood-2	Set 2	1.620	VE, Grav	Fiberglass	0	N/A	No	PLM-2	EO	
04/18/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-2	EO	
04/19/17	Hood-1	Set 1	1.620	VE, Grav	Fiberglass	0	N/A	No	PLM-2	LB	
04/19/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-2	LB	
04/19/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-2	LB	
04/20/17	Hood-3	Set 2	1.620	9002B	Fiberglass	0	N/A	No	PLM-2	EO	Cleaned hood after receiving 9002 bulks not properly double bagged.

LA = Libby Amphibole AC = Actinolite TR = Tremolite
AN = Anthophyllite CH = Chrysotile CR = Crocidolite AM = Amosite

Date	Hood ID	RI Liquid Set	RI Liquid Used	Sample Type(s) Prepared	Asbestos-Free Material Used	Total	Asbestos Type	Corrective Action Required	PLM ID	Analyst Initials	Comments
04/20/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-1	FL	
04/20/17	Hood-1	Set 1	1.620	9002B	Fiberglass	0	N/A	No	PLM-2	LB	
04/20/17	Hood-3	Set 2	1.620	9002B	Fiberglass	0	N/A	No	PLM-2	LB	
04/20/17	Hood-2	Set 2	1.620	9002B	Fiberglass	0	N/A	No	PLM-2	EO	
04/20/17	Hood-2	Set 2	1.620	9002B	Fiberglass	0	N/A	No	PLM-2	LB	
04/20/17	Hood-1	Set 1	1.550	9002B	Fiberglass	0	N/A	No	PLM-1	NT	
04/21/17	Hood-2	Set 2	1.620	9002B	Fiberglass	0	N/A	No	PLM-2	EO	
04/24/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-2	LB	
04/24/17	Hood-1	Set 1	1.620	VE, Grav	Fiberglass	0	N/A	No	PLM-2	LB	
04/25/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-2	EO	
04/27/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-2	LB	
04/28/17	Hood-3	Set 2	1.620	Grav	Fiberglass	0	N/A	No	PLM-2	EO	
04/28/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-1	JB	
04/28/17	Hood-2	Set 2	1.620	Grav	Fiberglass	0	N/A	No	PLM-2	EO	
05/01/17	Hood-1	Set 1	1.620	VE, Grav	Fiberglass	0	N/A	No	PLM-1	JB	
05/01/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-1	JB	
05/01/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-2	LB	
05/02/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-1	JB	
05/02/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-2	EO	
05/03/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-1	FL	
05/03/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-1	JB	
05/04/17	Hood-3	Set 1	1.550	9002S	Fiberglass	0	N/A	No	PLM-2	LB	
05/04/17	Hood-1	Set 1	1.550	VE, 9002S	Fiberglass	0	N/A	No	PLM-2	LB	
05/04/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-1	JB	
05/04/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-1	FL	

Date	Hood ID	RI Liquid Set	RI Liquid Used	Sample Type(s) Prepared	Asbestos-Free Material Used	Total	Asbestos Type	Corrective Action Required	PLM ID	Analyst Initials	Comments
05/04/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-2	EO	
05/05/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-2	LB	
05/05/17	Hood-1	Set 1	1.620	VE, Grav	Fiberglass	0	N/A	No	PLM-2	LB	
05/05/17	Hood-1	Set 1	1.620	VE, Grav	Fiberglass	0	N/A	No	PLM-1	JB	
05/05/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-1	JB	
05/08/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-2	LB	
05/08/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-1	NT	
05/08/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-1	NT	
05/11/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-1	JB	
05/11/17	Hood-3	Set 2	1.620	Grav	Fiberglass	0	N/A	No	PLM-1	NT	
05/11/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-1	NT	
05/12/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-2	LB	
05/12/17	Hood-1	Set 1	1.620	Grav, VE	Fiberglass	0	N/A	No	PLM-2	LB	
05/15/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-2	LB	
05/15/17	Hood-1	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-1	JB	
05/15/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-1	JB	
05/16/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-1	JB	
05/16/17	Hood-1	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-1	JB	
05/16/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-1	FL	
05/16/17	Hood-3	Set 2	1.620	PE	Fiberglass	0	N/A	No	PLM-1	DK	
05/17/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-2	LB	
05/17/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-1	FL	
05/17/17	Hood-3	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-2	LB	
05/18/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-2	LB	
05/19/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-2	LB	

Date	Hood ID	RI Liquid Set	RI Liquid Used	Sample Type(s) Prepared	Asbestos-Free Material Used	Total	Asbestos Type	Corrective Action Required	PLM ID	Analyst Initials	Comments
05/19/17	Hood-1	Set 1	1.620	VE, Grav	Fiberglass	0	N/A	No	PLM-2	LB	
05/19/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-1	JB	
05/19/17	Hood-3	Set 1	1.620	9002S	Fiberglass	0	N/A	No	PLM-1	JB	
05/19/17	Hood-1	Set 1	1.620	VE, 9002S	Fiberglass	0	N/A	No	PLM-1	JB	
05/22/17	Hood-2	Set 2	1.620	VE	Fiberglass	0	N/A	No	PLM-1	FL	
05/22/17	Hood-3	Set 1	1.620	Grav	Fiberglass	0	N/A	No	PLM-1	NT	
05/22/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-1	NT	
05/23/17	Hood-1	Set 1	1.620	VE	Fiberglass	0	N/A	No	PLM-2	LB	

TechLaw, Inc.
ESAT Region 8
16194 W. 45th Drive
Golden, CO 80403

PLM-1 Alignment Check (Nikon 50i Pol)

Logbook #R8-LB-PLM-035

Start Date: 02/05/2016

Date	Objective Centering	Substage Condenser Alignment	Polarizer/ Analyzer Alignment	Ocular Cross-hairs Alignment	Analyst Initials	Comments
03/15/17	☑	☑	☑	☑	FL	
03/20/17	☑	☑	☑	☑	FL	
03/21/17	☑	☑	☑	☑	FL	
03/27/17	☑	☑	☑	☑	DK	
03/28/17	☑	☑	☑	☑	ND	
03/28/17	☑	☑	☑	☑	NT	
03/29/17	☑	☑	☑	☑	ND	
03/29/17	☑	☑	☑	☑	JB	
03/30/17	☑	☑	☑	☑	DK	
03/30/17	☑	☑	☑	☑	ND	
03/30/17	☑	☑	☑	☑	JB	
03/30/17	☑	☑	☑	☑	NT	
03/31/17	☑	☑	☑	☑	NT	
04/07/17	☑	☑	☑	☑	JB	
04/10/17	☑	☑	☑	☑	DK	
04/10/17	☑	☑	☑	☑	JB	
04/11/17	☑	☑	☑	☑	JB	
04/12/17	☑	☑	☑	☑	JB	
04/12/17	☑	☑	☑	☑	DK	
04/13/17	☑	☑	☑	☑	JB	
04/13/17	☑	☑	☑	☑	EO	
04/14/17	☑	☑	☑	☑	JB	
04/14/17	☑	☑	☑	☑	DK	
04/20/17	☑	☑	☑	☑	FL	
04/20/17	☑	☑	☑	☑	NT	
04/21/17	☑	☑	☑	☑	LB	
04/21/17	☑	☑	☑	☑	NT	
04/27/17	☑	☑	☑	☑	JB	
04/27/17	☑	☑	☑	☑	ND	
04/28/17	☑	☑	☑	☑	ND	
04/28/17	☑	☑	☑	☑	JB	
05/01/17	☑	☑	☑	☑	JB	
05/01/17	☑	☑	☑	☑	JB	
05/02/17	☑	☑	☑	☑	JB	
05/03/17	☑	☑	☑	☑	JB	

Date	Objective Centering	Substage Condenser Alignment	Polarizer/ Analyzer Alignment	Ocular Cross-hairs Alignment	Analyst Initials	Comments
05/03/17	☑	☑	☑	☑	FL	
05/03/17	☑	☑	☑	☑	JB	
05/04/17	☑	☑	☑	☑	JB	
05/04/17	☑	☑	☑	☑	FL	
05/04/17	☑	☑	☑	☑	FL	
05/05/17	☑	☑	☑	☑	JB	
05/05/17	☑	☑	☑	☑	FL	
05/08/17	☑	☑	☑	☑	JB	
05/08/17	☑	☑	☑	☑	NT	
05/10/17	☑	☑	☑	☑	JB	
05/10/17	☑	☑	☑	☑	NT	
05/11/17	☑	☑	☑	☑	JB	
05/11/17	☑	☑	☑	☑	NT	
05/12/17	☑	☑	☑	☑	JB	
05/15/17	☑	☑	☑	☑	JB	
05/15/17	☑	☑	☑	☑	NT	
05/16/17	☑	☑	☑	☑	JB	
05/16/17	☑	☑	☑	☑	FL	
05/16/17	☑	☑	☑	☑	DK	
05/17/17	☑	☑	☑	☑	FL	
05/17/17	☑	☑	☑	☑	FL	
05/18/17	☑	☑	☑	☑	FL	
05/18/17	☑	☑	☑	☑	JB	
05/19/17	☑	☑	☑	☑	JB	
05/22/17	☑	☑	☑	☑	FL	
05/22/17	☑	☑	☑	☑	NT	
05/23/17	☑	☑	☑	☑	FL	

TechLaw, Inc.
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16194 W. 45th Drive
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PLM-2 Alignment Check (Zeiss Axioskop 40 Pol)

Logbook #R8-LB-PLM-036

Start Date: 02/05/2016

Date	Objective Centering	Substage Condenser Alignment	Polarizer/ Analyzer Alignment	Ocular Cross-hairs Alignment	Analyst Initials	Comments
01/03/17	☑	☑	☑	☑	EO	
01/23/17	☑	☑	☑	☑	EO	
01/26/17	☑	☑	☑	☑	DK	
01/27/17	☑	☑	☑	☑	ND	
01/31/17	☑	☑	☑	☑	LB	
02/01/17	☑	☑	☑	☑	EO	
02/13/17	☑	☑	☑	☑	DK	
02/13/17	☑	☑	☑	☑	EO	
02/21/17	☑	☑	☑	☑	EO	
02/22/17	☑	☑	☑	☑	EO	
02/22/17	☑	☑	☑	☑	DK	
02/24/17	☑	☑	☑	☑	DK	
02/27/17	☑	☑	☑	☑	LB	
02/28/17	☑	☑	☑	☑	LB	
02/28/17	☑	☑	☑	☑	FL	
03/02/17	☑	☑	☑	☑	LB	
03/03/17	☑	☑	☑	☑	EO	
03/08/17	☑	☑	☑	☑	EO	
03/09/17	☑	☑	☑	☑	EO	
03/13/17	☑	☑	☑	☑	EO	
03/14/17	☑	☑	☑	☑	EO	
03/15/17	☑	☑	☑	☑	EO	
03/17/17	☑	☑	☑	☑	EO	
03/23/17	☑	☑	☑	☑	EO	
03/27/17	☑	☑	☑	☑	LB	
03/28/17	☑	☑	☑	☑	LB	
03/28/17	☑	☑	☑	☑	DK	
03/29/17	☑	☑	☑	☑	LB	
03/29/17	☑	☑	☑	☑	DK	
03/30/17	☑	☑	☑	☑	EO	
03/30/17	☑	☑	☑	☑	LB	
03/31/17	☑	☑	☑	☑	EO	
04/03/17	☑	☑	☑	☑	EO	
04/04/17	☑	☑	☑	☑	EO	
04/05/17	☑	☑	☑	☑	EO	

Date	Objective Centering	Substage Condenser Alignment	Polarizer/ Analyzer Alignment	Ocular Cross-hairs Alignment	Analyst Initials	Comments
04/07/17	☑	☑	☑	☑	LB	
04/10/17	☑	☑	☑	☑	EO	
04/11/17	☑	☑	☑	☑	EO	
04/12/17	☑	☑	☑	☑	EO	
04/13/17	☑	☑	☑	☑	EO	
04/13/17	☑	☑	☑	☑	DK	
04/14/17	☑	☑	☑	☑	EO	
04/17/17	☑	☑	☑	☑	EO	
04/18/17	☑	☑	☑	☑	EO	
04/19/17	☑	☑	☑	☑	LB	
04/19/17	☑	☑	☑	☑	EO	
04/19/17	☑	☑	☑	☑	LB	
04/20/17	☑	☑	☑	☑	LB	
04/21/17	☑	☑	☑	☑	EO	
04/24/17	☑	☑	☑	☑	LB	
04/25/17	☑	☑	☑	☑	LB	
04/26/17	☑	☑	☑	☑	EO	
04/27/17	☑	☑	☑	☑	LB	
04/28/17	☑	☑	☑	☑	EO	
05/01/17	☑	☑	☑	☑	LB	
05/02/17	☑	☑	☑	☑	LB	
05/02/17	☑	☑	☑	☑	EO	
05/04/17	☑	☑	☑	☑	EO	
05/04/17	☑	☑	☑	☑	LB	
05/05/17	☑	☑	☑	☑	LB	
05/08/17	☑	☑	☑	☑	LB	
05/10/17	☑	☑	☑	☑	LB	
05/12/17	☑	☑	☑	☑	LB	
05/15/17	☑	☑	☑	☑	LB	
05/16/17	☑	☑	☑	☑	LB	
05/17/17	☑	☑	☑	☑	LB	
05/17/17	☑	☑	☑	☑	LB	
05/18/17	☑	☑	☑	☑	LB	
05/19/17	☑	☑	☑	☑	ND	
05/19/17	☑	☑	☑	☑	LB	

Date	Objective Centering	Substage Condenser Alignment	Polarizer/ Analyzer Alignment	Ocular Cross-hairs Alignment	Analyst Initials	Comments
05/19/17	☑	☑	☑	☑	LB	
05/22/17	☑	☑	☑	☑	ND	
05/23/17	☑	☑	☑	☑	LB	

TechLaw, Inc.
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Refractive Index Liquid Contamination Check Log (B-130)

Logbook #R8-LB-PLM-040

Start Date: 02/01/2017

Date	RI Liquid			Room or Liquid Temp	Asbestos Bundles Detected					Acceptable	PLM ID	Analyst Initials
	Set #	Labeled RI $n_D^{25°C}$	Series		# LA	# OA	OA Type	# CH	Total			
02/01/17	Set 2	1.62	E	21.3°C	0	0	N/A	0	0	True	PLM-2	EO
02/01/17	Set 1	1.55	E	21.3°C	0	0	N/A	0	0	True	PLM-2	EO
02/01/17	Set 1	1.62	E	21.3°C	0	0	N/A	0	0	True	PLM-2	EO
02/01/17	Set 1	1.64	E	21.3°C	0	0	N/A	0	0	True	PLM-2	EO
02/01/17	Set 1	1.68	B	21.3°C	0	0	N/A	0	0	True	PLM-2	EO
03/03/17	Set 1	1.55	E	21.6°C	0	0	N/A	0	0	True	PLM-2	EO
03/03/17	Set 1	1.62	E	21.6°C	0	0	N/A	0	0	True	PLM-2	EO
03/03/17	Set 1	1.64	E	21.6°C	0	0	N/A	0	0	True	PLM-2	EO
03/03/17	Set 1	1.68	B	21.6°C	0	0	N/A	0	0	True	PLM-2	EO
03/03/17	Set 2	1.62	E	21.7°C	0	0	N/A	0	0	True	PLM-2	EO
04/03/17	Set 1	1.55	E	21.9°C	0	0	N/A	0	0	True	PLM-2	EO
04/03/17	Set 1	1.62	E	21.9°C	0	0	N/A	0	0	True	PLM-2	EO
04/03/17	Set 1	1.64	E	21.9°C	0	0	N/A	0	0	True	PLM-2	EO
04/03/17	Set 1	1.68	B	21.9°C	0	0	N/A	0	0	True	PLM-2	EO
04/03/17	Set 2	1.62	E	21.9°C	0	0	N/A	0	0	True	PLM-2	EO
04/17/17	Set 1	1.55	E	20.8°C	0	0	N/A	0	0	True	PLM-2	EO
04/17/17	Set 1	1.62	E	20.8°C	0	0	N/A	0	0	True	PLM-2	EO
04/17/17	Set 1	1.64	E	20.8°C	0	0	N/A	0	0	True	PLM-2	EO
04/17/17	Set 1	1.68	B	20.8°C	0	0	N/A	0	0	True	PLM-2	EO
04/17/17	Set 2	1.62	E	20.8°C	0	0	N/A	0	0	True	PLM-2	EO
04/20/17	Set 2	1.62	E	20.8°C	0	0	N/A	0	0	True	PLM-2	LB
04/20/17	Other	1.55	E	20.8°C	0	0	N/A	0	0	True	PLM-2	LB
04/20/17	Set 1	1.55	E	20.8°C	0	0	N/A	0	0	True	PLM-2	LB
04/20/17	Set 1	1.62	E	20.8°C	0	0	N/A	0	0	True	PLM-2	LB

LA = Libby Amphibole AC = Actinolite TR = Tremolite
AN = Anthophyllite CH = Chrysotile CR = Crocidolite AM = Amosite
N/A = Not Applicable

R8-LB-PLM-024 - Refractive Index Liquid Contamination Check Log (B-130)

16194 W. 45th Drive
Golden, CO 80403

Date	RI Liquid			Room or Liquid Temp	Asbestos Bundles Detected					Acceptable	PLM ID	Analyst Initials
	Set #	Labeled RI $n_D^{25°C}$	Series		# LA	# OA	OA Type	# CH	Total			
04/20/17	Set 1	1.64	E	20.8°C	0	0	N/A	0	0	True	PLM-2	LB
04/20/17	Set 1	1.68	B	20.8°C	0	0	N/A	0	0	True	PLM-2	LB
04/20/17	Other	1.55	E	20.8°C	0	0	N/A	0	0	True	PLM-2	LB
05/01/17	Set 1	1.55	E	21.0°C	0	0	N/A	0	0	True	PLM-2	LB
05/01/17	Set 1	1.62	E	21.0°C	0	0	N/A	0	0	True	PLM-2	LB
05/01/17	Set 1	1.64	E	21.0°C	0	0	N/A	0	0	True	PLM-2	LB
05/01/17	Set 1	1.68	B	21.0°C	0	0	N/A	0	0	True	PLM-2	LB
05/01/17	Set 2	1.62	E	21.0°C	0	0	N/A	0	0	True	PLM-2	LB
05/01/17	Other	1.55	E	21.0°C	0	0	N/A	0	0	True	PLM-2	LB
05/18/17	Set 1	1.55	E	21.2°C	0	0	N/A	0	0	True	PLM-2	LB
05/18/17	Set 1	1.62	E	21.2°C	0	0	N/A	0	0	True	PLM-2	LB
05/18/17	Set 1	1.64	E	21.2°C	0	0	N/A	0	0	True	PLM-2	LB
05/18/17	Set 1	1.68	B	21.2°C	0	0	N/A	0	0	True	PLM-2	LB
05/18/17	Set 2	1.62	E	21.2°C	0	0	N/A	0	0	True	PLM-2	LB

LA = Libby Amphibole AC = Actinolite TR = Tremolite
AN = Anthophyllite CH = Chrysotile CR = Crocidolite AM = Amosite
N/A = Not Applicable

TechLaw, Inc.
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Golden, CO 80403

Refractive Index Liquid Calibration Log (B-130)

Logbook #R8-LB-PLM-039

Start Date: 02/01/2017

	RI Liquid			Cargille Glass		CSDS Color of Glass							
Date	Set #	Labeled RI $n_D^{25°C}$	Series	Labeled RI	Lot #	Predominant Color	WaveLength λ_0	Room or Liquid Temp	Calibrate Refractive Index	Abs. Differenc	Acceptable	PLM ID	Analyst Initials
02/01/17	Set 2	1.62	E	1.62	D	Blue	579nm	21.3°C	1.618	0.002	True	PLM-2	EO
02/01/17	Set 1	1.55	E	1.55	C	Blue	583nm	21.3°C	1.549	0.001	True	PLM-2	EO
02/01/17	Set 1	1.62	E	1.62	D	Blue	607nm	21.3°C	1.620	0.000	True	PLM-2	EO
02/01/17	Set 1	1.64	E	1.64	C	Purple	568nm	21.3°C	1.640	0.000	True	PLM-2	EO
02/01/17	Set 1	1.68	B	1.68	D	Light Blue-Green	663nm	21.3°C	1.683	0.003	True	PLM-2	EO
03/02/17	Other	1.568	A	1.57	D	Blue	569nm	21.5°C	1.569	0.001	True	PLM-1	JB
03/02/17	Other	1.572	A	1.57	D	Blue-Green	640nm	21.6°C	1.572	0.000	True	PLM-1	JB
03/02/17	Other	1.576	A	1.58	C	Purple	552nm	21.6°C	1.576	0.000	True	PLM-1	JB
03/03/17	Set 1	1.55	E	1.55	C	Blue	590nm	21.6°C	1.550	0.000	True	PLM-2	EO
03/03/17	Set 1	1.62	E	1.62	D	Blue-Green	620nm	21.6°C	1.620	0.000	True	PLM-2	EO
03/03/17	Set 1	1.64	E	1.64	C	Blue	580nm	21.6°C	1.641	0.001	True	PLM-2	EO
03/03/17	Set 1	1.68	B	1.68	D	Blue-Green	640nm	21.6°C	1.681	0.001	True	PLM-2	EO
03/03/17	Set 2	1.62	E	1.62	D	Blue-Green	620nm	21.7°C	1.620	0.000	True	PLM-2	EO
04/03/17	Set 1	1.55	E	1.55	C	Blue	589nm	21.9°C	1.550	0.000	True	PLM-2	EO
04/03/17	Set 1	1.62	E	1.62	D	Blue-Green	620nm	21.9°C	1.620	0.000	True	PLM-2	EO
04/03/17	Set 1	1.64	E	1.64	C	Blue	580nm	21.9°C	1.641	0.001	True	PLM-2	EO
04/03/17	Set 1	1.68	B	1.68	D	Blue-Green	640nm	21.9°C	1.681	0.001	True	PLM-2	EO
04/03/17	Set 2	1.62	E	1.62	D	Blue	600nm	21.9°C	1.620	0.000	True	PLM-2	EO
04/17/17	Set 1	1.55	E	1.55	C	Blue-Green	620nm	20.8°C	1.552	0.002	True	PLM-2	EO
04/17/17	Set 1	1.62	E	1.62	D	Blue-Green	620nm	20.8°C	1.620	0.000	True	PLM-2	EO

LA = Libby Amphibole AC = Actinolite TR = Tremolite
AN = Anthophyllite CH = Chrysotile CR = Crocidolite AM = Amosite

	RI Liquid			Cargille Glass		CSDS Color of Glass							
Date	Set #	Labeled RI $n_D^{25°C}$	Series	Labeled RI	Lot #	Predominant Color	WaveLength λ_0	Room or Liquid Temp	Calibrate Refractive Index	Abs. Differenc	Acceptable	PLM ID	Analyst Initials
04/17/17	Set 1	1.64	E	1.64	C	Blue	580nm	20.8°C	1.641	0.001	True	PLM-2	EO
04/17/17	Set 1	1.68	B	1.68	D	Light Blue-Green	660nm	20.8°C	1.683	0.003	True	PLM-2	EO
04/17/17	Set 2	1.62	E	1.62	D	Blue	600nm	20.8°C	1.619	0.001	True	PLM-2	EO
04/20/17	Set 2	1.62	E	1.62	D	Blue	600nm	20.8°C	1.619	0.001	True	PLM-2	LB
04/20/17	Other	1.55	E	1.55	C	Blue-Green	620nm	20.8°C	1.552	0.002	True	PLM-2	LB
04/20/17	Set 1	1.55	E	1.55	C	Blue-Green	620nm	20.8°C	1.552	0.002	True	PLM-2	LB
04/20/17	Set 1	1.62	E	1.62	D	Blue	600nm	20.8°C	1.619	0.001	True	PLM-2	LB
04/20/17	Set 1	1.64	E	1.64	C	Blue	580nm	20.8°C	1.641	0.001	True	PLM-2	LB
04/20/17	Set 1	1.68	B	1.68	D	Light Blue-Green	660nm	20.8°C	1.682	0.002	True	PLM-2	LB
04/20/17	Other	1.55	E	1.55	C	Blue-Green	620nm	20.8°C	1.552	0.002	True	PLM-2	LB
05/01/17	Set 1	1.55	E	1.55	C	Blue	611nm	21.0°C	1.551	0.001	True	PLM-2	LB
05/01/17	Set 1	1.62	E	1.62	D	Blue	582nm	21.0°C	1.618	0.002	True	PLM-2	LB
05/01/17	Set 1	1.64	E	1.64	C	Blue	575nm	21.0°C	1.640	0.000	True	PLM-2	LB
05/01/17	Set 1	1.68	B	1.68	D	Light Blue-Green	642nm	21.0°C	1.681	0.001	True	PLM-2	LB
05/01/17	Set 2	1.62	E	1.62	D	Blue	585nm	21.0°C	1.618	0.002	True	PLM-2	LB
05/01/17	Other	1.55	E	1.55	C	Blue	602nm	21.0°C	1.551	0.001	True	PLM-2	LB
05/18/17	Set 1	1.55	E	1.55	C	Blue	597nm	21.2°C	1.550	0.000	True	PLM-2	LB
05/18/17	Set 1	1.62	E	1.62	D	Blue	582nm	21.2°C	1.618	0.002	True	PLM-2	LB
05/18/17	Set 1	1.64	E	1.64	C	Blue	577nm	21.2°C	1.641	0.001	True	PLM-2	LB
05/18/17	Set 1	1.68	B	1.68	D	Blue-Green	621nm	21.2°C	1.679	0.001	True	PLM-2	LB

LA = Libby Amphibole AC = Actinolite TR = Tremolite
AN = Anthophyllite CH = Chrysotile CR = Crocidolite AM = Amosite

R8-LB-PLM-033 - Refractive Index Liquid Calibration Log (B-130)

16194 W. 45th Drive
Golden, CO 80403

	RI Liquid			Cargille Glass		CSDS Color of Glass							
Date	Set #	Labeled RI $n_D^{25°C}$	Series	Labeled RI	Lot #	Predominant Color	WaveLength λ_0	Room or Liquid Temp	Calibrate Refractive Index	Abs. Differenc	Acceptable	PLM ID	Analyst Initials
05/18/17	Set 2	1.62	E	1.62	D	Blue	582nm	21.2°C	1.618	0.002	True	PLM-2	LB

LA = Libby Amphibole AC = Actinolite TR = Tremolite
AN = Anthophyllite CH = Chrysotile CR = Crocidolite AM = Amosite

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EPA Region 8 Laboratory
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Golden, CO 80403

PLM LABORATORY AIR MONITORING BY TEM-AHERA
(Rooms B129 & B130)

ESAT
EPA Region 8 Laboratory

16194 W. 45th Drive
Golden, CO 80403

PLM LABORATORY AIR MONITORING BY TEM-AHERA
(Rooms B129 and B130)

Sample Number	Sample Date	Sample Description (Type-Location-Sampler)	Volume (L)	Work Order or Job Number	Analysis Date	Structures Counted	Pass/Fail	Comments	Initials
IA-00061	6/16/16	Personal - Zeiss - LB	1200	A160228	6/30/16	0	Pass Fail		NO
IA-00062	6/17/16	Personal - Nikon -	1207	A160228	6/30/16	0	Pass Fail		NO
IA-00063	6/17/16	Personal - Hood - FL	1207	A160228	6/30/16	0	Pass Fail		NO
IA-00064	9/13/16	PLM Area - B129	1200	A160572	10/3/16	0	Pass Fail		EO
IA-00065	9/13/16	B130 Hood 2 personnel	1200	A160572 A160572	10/3/16	0	Pass Fail		EO
IA-00066	9/14/16	B130 Area	1200	A160572	10/3/16	0	Pass Fail	Workers back & forth w/ door propped open	EO
IA-00067	9/14/16	B130 Hood 1 personnel	1200	A160572	10/3/16	0	Pass Fail		EO
IA-00068	12/06/16	PLM Scope 1 -	1200	A160748	12/14/16	0	Pass Fail		JB
IA-00069	12/6/16	B130 PLM Prep area	1200	A160748	12/14/16	0	Pass Fail		LB
IA-00070	12/07/16	~~B129~~ B130 Hood 3	1200	A160748	12/14/16	0	Pass Fail		RL
IA-00071	12/9/16	B129 PLM Analysis area	1200	A160748	12/14/16	0	Pass Fail		RL
IA-00072	12/8/16	B129 PLM Scope 2 - personal	1200	A160748	12/14/16	0	Pass Fail		RL
IA-00073	3/13/17	B130 - PLM Prep Area	1200	A170020	3/24/17	0	Pass Fail		EO
IA-00074	3/15/17	B129 - PLM Analysis area	1200	A170020	3/24/17	0	Pass Fail		EO
IA-00075							Pass Fail		
IA-00076							Pass Fail		
IA-00077							Pass Fail		
IA-00078							Pass Fail		
IA-00079							Pass Fail		
IA-00080							Pass Fail		
IA-00081							Pass Fail		
IA-00082							Pass Fail		
IA-00083							Pass Fail		
IA-00084							Pass Fail		
IA-00085							Pass Fail		
IA-00086							Pass Fail		
IA-00087							Pass Fail		
IA-00088							Pass Fail		
IA-00089							Pass Fail		
IA-00090							Pass Fail		

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EPA Region 8 Laboratory
16194 W. 45th Drive
Golden, CO 80403

AIR PUMP CALIBRATION

AIR PUMP CALIBRATION

16194 W 45th Dr.
Golden, CO 80403

Sample No.	Location	Rotometer ID	Starting Flow Rate (LPM)	Sample Start Time	Sample End Time	Ending Flow Rate (LPM)	Average Flow Rate (LPM)	Date	Initials
LT-00219	D-123 LabConco	R8 Lab	10.0	0710	0910	10.0	10.0	6/20/16	FL
LT-00220	D-123 Safe air	R8 Lab	10.0	0915	1115	10.0	10.0	6/20/16	FL
LT-00221	B-147 TEM Lab	R8 Lab	10.0	1300	1500	10.0	10.0	6/20/16	FL
IA-00064	B-129 PLM Area	R8 Lab	10.0	10:53a	12:53p	10.0	10.0	9/13/16	EO
IA-00065	B-130 Hood 2 personal	R8 Lab	10.0	12:59pm	2:59p	10.0	10.0	9/13/16	EO
IA-00066	B-130 Prep Area	R8 Lab	10.0	07:33a	9:33a	10.0	10.0	9/14/16	EO
IA-00067	B-130 Hood 1 personal	R8 Lab	10.0	12:32pm	2:32p	10.0	10.0	9/14/16	EO
LT-00253	B-147 TEM Area	R8 Lab	10.0	8:40am	10:40am	10.0	10.0	9/15/16	EO
LT-00255	D-123 LabConco	R8 Lab	10.0	1:33pm	3:33pm	10.0	10.0	9/23/16	EO
LT-00255	D-123 Safe Air	R8 Lab	10.0	10:40a	12:40p	10.0	10.0	9/26/16	EO
LT-00266	D-123 LabConco	R8 Lab	10.0	11:07am	1:07pm	10.0	10.0	12/02/16	EO
LT-00267	D-123 Safe air	R8 Lab	10.0	0910	1110	10.0	10.0	12/5/16	FL
LT-00268	B-147 Grid loading	R8 Lab	10.0	1122	1322	10.0	10.0	12/5/16	FL
IA-00068	B129 PLM Scope 1	R8 Lab	10	0730	09:30	10	10	12/06/16	JB
IA-00069	B130 Preparation	R8 Lab	10.0	1241	1921	10.0	10.0	12/6/16	FL
IA-00070	B129 Hood 3	R8 Lab LS 12/07/16	10.0	8:30	10:30	10.0	10.0	12/07/16	LS
IA-00071	B129 PLM Analysis Area	R8 Lab	10.0	1253	1453	10.0	10.0	12/7/16	FL
IA-00072	B129 PLM Scope 2 Personal	R8 Lab	10.0	9:28am	11:28am	10.0	10.0	12/8/16	EO
LT-00286	D-123 Laboratory Hood	R8 Lab	10.0	10:55	12:55	10.0	10.0	3/10/17	FL
LT-00285	B-147 - TEM area	R8 Lab	10.0	1316	1516	10.0	10.0	3/10/17	FL

AIR PUMP CALIBRATION

16194 W 45th Dr.
Golden, CO 80403

Sample No.	Location	Rotometer ID	Starting Flow Rate (LPM)	Sample Start Time	Sample End Time	Ending Flow Rate (LPM)	Average Flow Rate (LPM)	Date	Initials
IA-00073	B-130 PLM prep	R8 Lab	10.0	1235	1435	10.0	10.0	3/13/17	PL
LT-60287	D-123 Safe air hood	R8 Lab	10.0	1202	1402	10.0	10.0	3/14/17	PL
IA-00074	B-129 PLM Analysis	R8 Lab	10.0	0843	1043	10.0	10.0	3/15/17	PL

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Golden, CO 80403

ANALYTICAL BALANCE CALIBRATION (B130)

Logbook # R8-LB-PLM-038

TechLaw, Inc,
ESAT Region 8

16194 W. 45th Drive
Golden, CO 80403

ANALYTICAL BALANCE CALIBRATION (ROOM B130)

Date	Weights (g)				Accept	Comments	Analyst Initials
	0.0500	1.0000	20.0000	50.0000			
12/19/16	0.0501	1.0005	19.9996	49.9985	(Yes) No	—	EO
12/22/16	0.0501	0.9997	19.9992	49.9980	(Yes) No	—	DK
12/23/16	0.0500	0.9999	~~19.9~~ 20.0012 LB 12/23/16	50.0027	(Yes) No	—	LB
12/27/16	0.0501	1.0002	19.9999	50.0006	(Yes) No	—	EO
12/28/16	0.0500	0.9999	20.0006	50.0025	(Yes) No	—	LB
12/29/16	0.0502	1.0004	20.0008	50.0023	(Yes) No	—	EO
3/9/17	0.0502	1.0001	20.0000	50.0002	(Yes) No	—	EO
3/13/17	0.0501	0.9998	19.9997	49.9993	(Yes) No	—	EO
3/14/17	0.0499	0.9998	19.9995	49.9998	(Yes) No	—	ND
4/5/17	0.0505	0.9999	20.0000	50.0000	(Yes) No	—	EO
4/10/17	0.0503	1.0007	20.0005	50.0006	(Yes) No	—	EO
04/12/17	0.0502	1.0005	20.0001	50.0003	(Yes) No	—	JB
4/13/17	0.0504	1.0001	20.0000	49.9997	(Yes) No	—	EO
4/17/17	0.0501	1.0006	20.0002	49.9999	(Yes) No	—	EO
04/18/17	0.0503	1.0001	19.9998	49.9994	(Yes) No	—	LB
04/24/17	0.0500	1.0000	19.9997	49.9990	(Yes) No	—	LB
4/28/17	0.0500	1.0003	19.9998	50.0001	(Yes) No	—	EO
05/01/17	0.0505	1.0001	19.9996	49.9998	(Yes) No	—	JB
05/05/17	0.0501	1.0000	19.9996	49.9999	(Yes) No	—	LB
05/08/17	0.0499	0.9998	19.9995	49.9992	(Yes) No		TT
05/11/17	~~0.05~~ TT 05/11/17 0.0504	0.9999	19.9994	49.9994	(Yes) No	—	TT
05/12/17	0.0500	0.9999	19.9995	49.9968	(Yes) No	—	LB
05/15/17	0.0503	1.0000	19.9999	50.0004	(Yes) No	—	JB
05/16/17	0.0500	1.0001	20.0002	50.0002	(Yes) No	—	JB
05/19/17	0.0503	1.0002	19.9998	50.0001	(Yes) No	—	LB
05/22/17	0.0505	1.0006	19.9999	49.9998	(Yes) No	—	TT
05/30/17	0.0500	1.0002	19.9996	49.9991	(Yes) No	—	LB
					Yes No		
					Yes No		
					Yes No		

Attachment H

USACE/CDM Data Validation Report

Libby Asbestos Superfund Site
Operable Unit 6

PLM Verification Report
2017 Test Pit Sampling

Project/Dataset Description: Libby Asbestos Superfund Site, 2017 Operable Unit 6 (OU6) Test Pit Soil Sampling

SUMMARY OF FINDINGS AND DATA QUALITY IMPLICATIONS

A verification of soil samples analyzed by polarized light microscopy-visual estimation (PLM-VE) and PLM gravimetric (PLM-Grav) methods for the 2017 Operable Unit 6 (OU6) Test Pit Soil Sampling was performed. The minimum verification frequency selected for this effort was 100%. This verification effort was based on the Libby OU6 EDDs and the final laboratory reports as provided by TechLaw.

Any issues identified in the verification process were categorized in the following manner:

Critical error: An error is identified in the result information.

Potential critical error: An error is identified in a critical data field which does not result in an error in the result information.

Non-critical discrepancy: A discrepancy is identified in a non-critical data field that does not impact the result information Non-critical data fields include, but are not limited to analysis lab identification (ID), SOP method, analysis date analyst, sample comments, instrument ID, and laboratory job number.

No critical errors, potential critical errors, or non-critical discrepancies were identified in the verification process for samples analyzed by PLM-VE or PLM-Grav.

The Data Verification Coordinator is required to perform a check of a minimum of 5% of the analyses verified to ensure that any potential issues were identified correctly. since only two primary field samples were included in this data verification, 100% of the data was verified. No deficiencies were noted.

RECOMMENDATIONS FOR FUTURE REVIEW AND VERIFICATION

There is no need to perform future review or verification efforts for this dataset because no errors or discrepancies were identified in the verification process.

Data Verifier _____ Date 6/16/17

Data Verification Coordinator _____ Date 6/16/17

PLM-VE SELECTION

Lab	Analyst	Number of PLM-VE Analysis			Number of PLM-VE Analysis Selected for Review		
		Detect	Non-Detect	Total	Detect	Non-Detect	Total
ESTA8	J. Bernard	0	5	5	0	5	5

CONSISTENCY REVIEW RESULTS – PLM-VE

Number of analyses reviewed: 5 of 5 (100% of total analyses selected)
Number of analyses with recording issues identified: 0 of 5 (0% of total analyses reviewed)

DATA TRANSFER TO THE PROJECT DATABASE RESULTS – PLM-VE

Number of analyses verified: 5 of 5 (100% of total analyses selected)
Number of analyses with data transfer issues identified: 0 of 5 (% of total analyses verified)

PLM-GRAV SELECTION

Lab	Analyst	Number of PLM-Grav Analysis			Number of PLM-Grav Analysis Selected for Review		
		Detect	Non-Detect	Total	Detect	Non-Detect	Total
ESTA8	E. Orthun	0	2	2	0	2	2

CONSISTENCY REVIEW RESULTS – PLM-GRAV

Number of analyses reviewed: 2 of 2 (100% of total analyses selected)
Number of analyses with recording issues identified: 0 of 2 (0% of total analyses reviewed)

DATA TRANSFER VERIFICATION RESULTS – PLM-GRAV

Number of analyses verified: 2 of 2 (100% of total analyses selected)
Number of analyses with data transfer issues identified: 0 of 2 (0% of total analyses verified)

COMMENTS

Attachment 1 (Data Summary Table for PLM-VE Verification) and Attachment 2 (Data Summary Table for PLM-Grav Verification), contain the details of the verification. Attachment 3 contains the data packages that were used for this verification effort.

REFERENCES

EPA (U.S. Environmental Protection Agency). 2012. *Standard Operating Procedure for PLM Data Review and Data Entry Verification.* SOP EPA-LIBBY-10. Produced by CDM Smith for the U.S. Environmental Protection Agency, Region 8. Revision 0 - August.

Attachment 1. Data Summary Table for PLM-VE Verification
Libby Asbestos Superfund Site - Operable Unit 6

Sample Number	Analysis Lab ID	Lab Job Number	Analysis Method	Method SOP	Instrument	Tag	Matrix	Lab Sample ID	Date Received	Analyiss Date	Analyst Name	Sample Appearance	Deviaiton	LA Bin	La Conc	OA Conc	OH Conc	Verifier's company	Verifier's Name	Verified Date
BG-00332	ESATR8	A170060	PLM-VE	SRC-LIBBY-03 (REV 3)	PLM-1	FG4	Soil	A170060-01	4/25/2017	5/2/2017	J. Bernard	Tan soil, fine	No	A	ND	ND	ND	USACE	M. Lordemann	6/16/2017
BG-00333	ESATR8	A170060	PLM-VE	SRC-LIBBY-03 (REV 3)	PLM-1	FG1	Soil	A170060-02	4/25/2017	5/2/2017	J. Bernard	Tan soil, fine	No	A	ND	ND	ND	USACE	M. Lordemann	6/16/2017
BG-00334	ESATR8	A170060	PLM-VE	SRC-LIBBY-03 (REV 3)	PLM-1	FG3	Soil	A170060-03	4/25/2017	5/2/2017	J. Bernard	Tan sand, fine	No	A	ND	ND	ND	USACE	M. Lordemann	6/16/2017
BF-00335	ESATR8	A170060	PLM-VE	SRC-LIBBY-03 (REV 3)	PLM-1	FG2	Soil	A170060-04	4/25/2017	5/2/2017	J. Bernard	Tan sand, fine	No	A	ND	ND	ND	USACE	M. Lordemann	6/16/2017
BG-00336	ESATR8	A170060	PLM-VE	SRC-LIBBY-03 (REV 3)	PLM-1	FG4	Soil	A170060-05	4/25/2017	5/2/2017	J. Bernard	Tan soil, fine	No	A	ND	ND	ND	USACE	M. Lordemann	6/16/2017

Notes:
CH = chrysotile
Conc. = concentration
ID = identification
LA = Libby amphibole asbestos
ND = non-detect
OA = other amphibole
PLM-VE = polarized light microscopy-visual estimation
SOP = standard operating procedure
USACE = US Army Corps of Engineers

Attachment 2. Data Summary Table for PLM-Grav Verification
Libby Asbestos Superfund Site - Operable Unit 6

Sample Number	Analysis Lab ID	Lab Job Number	Analysis Method	Method SOP	Tag	Matrix	Lab Sample ID	Date Received	Analyiss Date	Analyst Name	Sample Appearance	Comments	La Conc	OA Conc	OH Conc	Verifier's company	Verifier's Name	Verified Date
BG-00332	ESATR8	A170059	PLM-Grav	SRC-LIBBY-01 (REV 3)	C2	Soil	A170059-01	4/25/2017	5/1/2017	E. Orthun	Tan soil, coarse	Coarse and fine material observed	ND	ND	ND	USACE	M. Lordemann	6/16/2017
BG-00336	ESATR8	A170059	PLM-Grav	SRC-LIBBY-01 (REV 3)	C3	Soil	A170059-02	4/25/2017	5/1/2017	E. Orthun	Tan soil, coarse	Coarse and fine material observed	ND	ND	ND	USACE	M. Lordemann	6/16/2017

Notes:
CH = chrysotile
Conc. = concentration
ID = identification
LA = Libby amphibole asbestos
ND = non-detect
OA = other amphibole
PLM-VE = polarized light microscopy-visual estimation
SOP = standard operating procedure
USACE = US Army Corps of Engineers

Attachment 3. Data Packages

PLM- VE

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-VE

Prepared For: Don Goodrich, USEPA Region 8
Address: 1595 Wynkoop Street, Mail Stop 8EPR-PS, Denver, CO 80202

Laboratory Name: TechLaw, Inc. ESAT Region 8
Address: 16194 West 45th Drive, Golden, CO 80403

Report Authorization: 5-2-2017
Scott Walker, ESAT Region 8 Senior Analytical Chemist — Date

Standard Laboratory Data Package Checklist

Instructions: **Complete the following checklist and attach supporting documentation as outlined below.**

1	Laboratory Job No.:	A170060
2	Chain of Custody No.:	17-1009_FG
3	Date of sample receipt:	4/25/2017
4	Number of samples received:	5
5	Analytical Method:	PLM-VE
6	Method/SOP:	SRC-LIBBY-03 (REV 3)
7	SAP Analytical Summary No.:	OU6BG0816 (REV 2)
8	Test Report Correction No.:	C0
9	Condition of samples:	Acceptable
10	Technical Direction Form No.:	A150
11	Attachments:	

Chain of Custody form(s)
Case Narrative and any modification forms
Statement of Uncertainty
Analysis Results
Analytical Bench Sheet(s)

Report Verification: The quality control (QC) review signifies that all laboratory QC tasks were performed for the samples in this Laboratory Job Number, that this Analytical Test Report is accurate and complete, and that procedures fall within the required specifications.

Data Entry By (Initials and Date) JB 05/02/17

QC Review By (Initials and Date) LB 05/02/17

A170060

~~A170059~~ EO 4/25/17

Send To:
Lab: ESATR8
Lab Address: 16194 W. 45th Drive
Lab_Address2: Golden, CO 80403

From: ESAT Region 8/TechLaw _ CHAIN OF CUSTODY
TroyPrepLabLibby-MT
NoSamples: 5
RevisionNo

No: 17-1009_FG
Lab Contact: Landon Bailey
Lab Phone: (303) 312-7054
DateShipped: 4/24/2017

Lab #	Sample #	Tag	Collected	Analyses	Matrix	COCTurnaround	COCTurnaroundUnits
	BG-00332	FG4	4/20/2017	PLM-VE	Soil	10	Days
	BG-00333	FG1	4/20/2017	PLM-VE	Soil	10	Days
	BG-00334	FG3	4/21/2017	PLM-VE	Soil	10	Days
	BG-00335	FG2	4/24/2017	PLM-VE	Soil	10	Days
	BG-00336	FG4	4/24/2017	PLM-VE	Soil	10	Days

Special Instructions: SAP Analytical Summary # OU6BG0816 - Rev 2

SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
5	Andrea Wandler ESATR8-Troy	04/24/17 1014	Landon Bailey ESATR8	10:30 04/25/17	Acceptable

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-VE

CASE NARRATIVE

The TechLaw, Inc. ESAT Region 8 laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for bulk asbestos analysis by Polarized Light Microscopy (PLM) and is currently proficient in the NVLAP Bulk Asbestos Proficiency Testing program. The laboratory NVLAP Laboratory Identification Code is 200792-0.

NVLAP policy requires that this report may not be used by the client to claim product endorsement by NVLAP, National Institute of Standards and Technology (NIST), or any agency of the United States Government. This test report shall not be reproduced except in full, without written approval of the laboratory. This test report relates only to items tested.

The laboratory's Quality Assurance (QA) program requires that a minimum of 10% of all analyzed client samples be re-analyzed and logged into an internal QC tracking system. The results of these QC analyses for this Laboratory Job Number are provided in this Analytical Test Report as "LDC" (lab duplicate cross-check), "LDCR" (lab duplicate cross-check reprep) or "LDS" (lab duplicate self-check).

The following sections describe the analytical method used as indicated on Page 1, Line 5 of this report:

PLM-VE:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," with additional preparation and methodology for soil samples according to SRC-LIBBY-03, Revision 3, "Analysis of Asbestos Fibers in Fine Soil by Polarized Light Microscopy" and all current applicable Libby Lab Modification forms as specified in the relevant Sampling and Analysis Plan (SAP) Analytical Summary Sheet.

PLM-Grav:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," with additional preparation and methodology for soil samples according to SRC-LIBBY-01, Revision 3, "Qualitative Estimation of Asbestos in Coarse Soil by Visual Examination Using Stereomicroscopy and Polarized Light Microscopy" and all current applicable Libby Lab Modification forms as specified in the relevant SAP Analytical Summary Sheet.

PLM-PC400:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," according to ESAT Region 8 SOP PLM-01.01, "Bulk Asbestos Analysis by Polarized Light Microscopy," with the following modification: the Libby Amphibole suite of minerals are included in the tremolite-actinolite results.

PLM-600:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," according to ESAT Region 8 SOP PLM-01.01, "Bulk Asbestos Analysis by Polarized Light Microscopy."

Sample descriptions provided on the results spreadsheet may include both the client description (as listed on the COC) and the laboratory's description observed during stereomicroscopic examination when the two are different. The client description is listed first, then the laboratory's description is listed in brackets. For example, the COC may list "Floor tile" and the laboratory observes a green floor tile; the results will list "Floor tile [green]".

Additional Comments:

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-VE
ESAT Region 8 PLM Laboratory Statement of Uncertainty

The primary factor that contributes to random uncertainty of a PLM-600, PLM-VE and PLM-Grav analytical measurement is determined by the repeatability of an analysis. PLM-Grav analyses have additional uncertainty in a measurement due to the analytical balance which was calculated by the manufacturer as 0.1mg or 0.0001g. The following factors were identified to contribute to systematic uncertainty: sub-sampling of soils during preparation, variation in slide loading between analysts, interferences such as particles with similar optical properties as asbestos, ambiguity in the methods, and differences in analyst interpretation. Uncertainty contributed by field sampling conditions, soil grinding during the sample preparation at the Troy SPF, and shipment of samples is outside the laboratory's control and will not be evaluated by ESAT.

At the inception of the Libby Asbestos Superfund Site (referred to as the Libby Site), the EPA drafted reporting ranges called Bin Categories to further characterize the detection and quantification of asbestos at or below 1%. The majority of samples analyzed by ESAT are Non Detect (ND) or Trace (TR) as defined in site-specific SOP SRC-LIBBY-03 (current revision). With samples containing such a small quantity of asbestos, and the subjective nature of the PLM analytical method, uncertainty is virtually non-quantifiable in traditional statistical methodology. Therefore, zeros in the Quantitative Error table below are indicative of an analyst's reported result within one bin category difference of the original analytical results.

In addition to the quantitative error for client soil samples (stated below), analyst and laboratory accuracy, precision, and bias are determined from monthly reference slides, client samples, Round Robin samples, and NVLAP PE samples per NVLAP requirements (NIST Handbook 150-3 section 5.6 and 5.8) to maintain proficiency with bulk asbestos samples and standards.

Data Tables:

Quantitative Error (calculated using annual data from client QC samples in 2016)

Analyst Initials:	DK	NT	ND	JB	LB	FL	EO
Client QCs Analyzed	16	27	21	181	205	21	136
Client QC Error	0%	0%	4.8%	0%	0%	0%	0.7%

The data within the above table represents annual data from January - December 2016. Monthly updates to this table can be found in the monthly PLM QC Summary.

Qualitative Error (expressed as a percent of the total number of QC analyses for the ESAT Laboratory)

Total percentage of qualitative errors for the 2016 calendar year:	0.7%
Cumulative qualitative error rate from September 2007 - December 2016:	0.095%

Calculations:

Weight Percent

$$W_a = \frac{P_a * V_a * 100}{(100 - V_a) * P_m + (V_a * P_a)}$$

W_a = Weight % of a particular asbestos type
V_a = Volume % of asbestos
P_a = Density of Asbestos
P_m = Density of Matrix

Gravimetric Weight Percent

$$C_{\%} = \left(\frac{|W_a - W_s|}{W_s}\right) * 100$$

$C_{\%}$ = % concentration of a particular asbestos type
W_a = Overall weight of Sample
W_s =Weight of asbestos removed from sample

References:

Stewart, I. U. S. Department of the Interior, Environmental Protection Agency. (1988) Asbestos Content in Bulk Insulation Samples: Visual Estimates and Weight Composition . Washington D. C. : Office of Pesticides and Toxic Substances. EPA/560/5-88/011.

Taylor, J. (1997). *An introduction to error analysis: The study of uncertainties in physical measurements* (2nd ed.). Sausalito, Calif.: University Science Books.

Verkouteren, J. U. S. Department of Commerce, National Institute of Standards and Technology. (1997) Guide for Quality Control on the Qualitative and Quantitative Analysis of Bulk Asbestos Samples: Volume 1 . Galthersburg, MD: NISTR 5951.

PLM-VE Analysis Results

Laboratory Name: ESATR8 **Job Number:** A170060 **Date Received:** 04/25/2017 **SOP Name/Method:** SRC-LIBBY-03 (REV 3)

Client Sample Number	Tag	Lab Sample ID	QC Type	Date Analyzed	Analyst Name	Deviation	Sample Color Type/Texture	Homogeneous	Libby Amphibole (LA)			Other Amphibole (OA)			Chrysotile (CH)	
									Qual	CONC %	Bin	Qual	CONC %	Type	Qual	CONC %
BG-00332	FG4	A170060-01	NOT QC	05/01/2017	J. Bernard	No	Tan soil, fine	Yes	ND		A	ND			ND	
BG-00333	FG1	A170060-02	NOT QC	05/02/2017	J. Bernard	No	Tan soil, fine	Yes	ND		A	ND			ND	
BG-00334	FG3	A170060-03	NOT QC	05/02/2017	J. Bernard	No	Tan sand, fine	Yes	ND		A	ND			ND	
BG-00335	FG2	A170060-04	NOT QC	05/02/2017	J. Bernard	No	Tan sand, fine	Yes	ND		A	ND			ND	
BG-00336	FG4	A170060-05	NOT QC	05/02/2017	J. Bernard	No	Tan soil, fine	Yes	ND		A	ND			ND	

Client Sample Number	Tag	Lab Sample ID	QC Type	Habit	Fiber Color	Sign of Elongation	Pleochroism	Extinction Angle	Ref. Index α	Ref. Index γ	Birefringence	Analysis Status	Analysis Comments
BG-00332	FG4	A170060-01	NOT QC									Analyzed	
BG-00333	FG1	A170060-02	NOT QC									Analyzed	
BG-00334	FG3	A170060-03	NOT QC									Analyzed	
BG-00335	FG2	A170060-04	NOT QC									Analyzed	
BG-00336	FG4	A170060-05	NOT QC									Analyzed	

Laboratory Name: ESATR8
Work Order No.: A170060
Method/SOP: SRC-LIBBY-03 (REV 3)

LIBBY ASBESTOS SUPERFUND SITE
ANALYSIS BENCH SHEET (PLM-VE)

Doc. No.: TLF-23.03
Effective Date: 04/15/15

Client Sample No.	Tag	Lab Sample ID	QC Type	Date Analyzed	Analyst Initials	Deviation	Sample Color[1]	Sample Type/Texture (STEREOMICROSCOPIC EXAMINATION)	Homogeneity	Est. % LA	Est. % Other Asbestos	LA-Qual (ASBESTOS MINERALS OBSERVED)	LA-%	OA-Qual	OA-AF %	OA Type	CH-Qual	CH-AF %	Habit[2] (ASBESTOS OPTICAL PROPERTIES)	Fiber Color[1]	Sign of Elongation	Pleochroism	Extinction Angle[3]	Ref. Index (α)	Ref. Index (γ)	Birefringence[4]	RI Determined By[5]	Temperature (°C)	Type and % of Non-Asbestos Fibers (w/ optical properties[6]) (OTHER)	Non-Fibrous Matrix Materials (if known)[7]	Comments[8]
BG-00332	FG4	A170060-01	NOT QC LDC LDCR LDS	05/01/17	JB	Yes No	T	Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		Tr CELL H FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
BG-00333	FG1	A170060-02	NOT QC LDC LDCR LDS	05/02/17	JB	Yes No	T	Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		Tr CELL H FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
BG-00334	FG3	A170060-03	NOT QC LDC LDCR LDS	05/02/17	JB	Yes No	T	Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
BG-00335	FG2	A170060-04	NOT QC LDC LDCR LDS	05/02/17	JB	Yes No	T	Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
BG-00338	FG4	A170060-05	NOT QC LDC LDCR LDS	05/02/17	JB	Yes No	T	Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		Tr CELL H FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
			NOT QC LDC LDCR LDS			Yes No		Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
			NOT QC LDC LDCR LDS			Yes No		Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
			NOT QC LDC LDCR LDS			Yes No		Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
			NOT QC LDC LDCR LDS			Yes No		Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5
			NOT QC LDC LDCR LDS			Yes No		Soil Sand Fine Coarse	Yes No	ND TR	ND TR	ND TR < DET		ND < DET		AMOS CROC ANTH	ND < DET		AF NAF		POS NEG	YES NO	I P			L M H	BL DS		CELL FBGL OTHR SYN	A C F M O Q	1 2 3 4 5

[1] BL = Blue, BR = Brown, C = Colorless, G = Gray, GR = Green, R = Red, T = Tan, V = Violet, Y = Yellow; [2] AF= Asbestiform, NAF= Non-Asbestiform; [3] I = Inclined, P = Parallel; [4] L = Low, M = Moderate, H = High; [5] BL = Becke Lines, DS = Dispersion Staining; [6] B = High Birefringence, H = Habit, I = Isotropic, O = Opaque, P = Parallel Extinction, RI = Refractive Index, S = Sign of Elongation, U = Undulatory Extinction; [7] A = Amphibole, C = Cellulose, F = Feldspar, M = Mica, O = Opaques, Q = Quartz; [8] 1 = LA grain has striations, 2 = Some fibers length fast, 3 = Not analyzed per client request, 4 = PLM-1, 5 = PLM-2

Page 1 of 1

Attachment 3. Data Packages

PLM-Grav

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-Grav

Prepared For: Don Goodrich, USEPA Region 8
Address: 1595 Wynkoop Street, Mail Stop 8EPR-PS, Denver, CO 80202

Laboratory Name: TechLaw, Inc. ESAT Region 8
Address: 16194 West 45th Drive, Golden, CO 80403

Report Authorization: Scott Walker, ESAT Region 8 Senior Analytical Chemist — Date: 5-1-2017

Standard Laboratory Data Package Checklist

Instructions: **Complete the following checklist and attach supporting documentation as outlined below.**

1	Laboratory Job No.:	A170059
2	Chain of Custody No.:	17-1009_C
3	Date of sample receipt:	4/25/2017
4	Number of samples received:	2
5	Analytical Method:	PLM-Grav
6	Method/SOP:	SRC-LIBBY-01 (REV 3)
7	SAP Analytical Summary No.:	OU6BG0816 (REV 2)
8	Test Report Correction No.:	C0
9	Condition of samples:	Acceptable
10	Technical Direction Form No.:	A150
11	Attachments:	

Chain of Custody form(s)
Case Narrative and any modification forms
Statement of Uncertainty
Analysis Results
Analytical Bench Sheet(s)

Report Verification: The quality control (QC) review signifies that all laboratory QC tasks were performed for the samples in this Laboratory Job Number, that this Analytical Test Report is accurate and complete, and that procedures fall within the required specifications.

Data Entry By (Initials and Date) EO 5/1/17

QC Review By (Initials and Date) LB 05/01/17

A170059

EO 4/25/17 ~~A170060~~

Send To:
Lab: ESATR8
Lab Address: 16194 W. 45th Drive
Lab_Address2: Golden, CO 80403

From: ESAT Region 8/TechLaw _ CHAIN OF CUSTODY
TroyPrepLabLibby-MT
NoSamples: 2
RevisionNo

No: 17-1009_C
Lab Contact: Landon Bailey
Lab Phone: (303) 312-7054
DateShipped: 4/24/2017

Lab #	Sample #	Tag	Collected	Analyses	Matrix	COCTurnaround	COCTurnaroundUnits
	BG-00332	C2	4/20/2017	PLM-Grav	Soil	10	Days
	BG-00336	C3	4/24/2017	PLM-Grav	Soil	10	Days

Special Instructions: SAP Analytical Summary # OU6BG0816 - Rev 2

SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
2	Andrea Wandler ESATR8-Troy	04/24/17 10:45	Landon Bailey ESATR8	04/25/17 10:30	Acceptable

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-Grav

CASE NARRATIVE

The TechLaw, Inc. ESAT Region 8 laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for bulk asbestos analysis by Polarized Light Microscopy (PLM) and is currently proficient in the NVLAP Bulk Asbestos Proficiency Testing program. The laboratory NVLAP Laboratory Identification Code is 200792-0.

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The laboratory's Quality Assurance (QA) program requires that a minimum of 10% of all analyzed client samples be re-analyzed and logged into an internal QC tracking system. The results of these QC analyses for this Laboratory Job Number are provided in this Analytical Test Report as "LDC" (lab duplicate cross-check), "LDCR" (lab duplicate cross-check reprep) or "LDS" (lab duplicate self-check).

The following sections describe the analytical method used as indicated on Page 1, Line 5 of this report:

PLM-VE:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," with additional preparation and methodology for soil samples according to SRC-LIBBY-03, Revision 3, "Analysis of Asbestos Fibers in Fine Soil by Polarized Light Microscopy" and all current applicable Libby Lab Modification forms as specified in the relevant Sampling and Analysis Plan (SAP) Analytical Summary Sheet.

PLM-Grav:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," with additional preparation and methodology for soil samples according to SRC-LIBBY-01, Revision 3, "Qualitative Estimation of Asbestos in Coarse Soil by Visual Examination Using Stereomicroscopy and Polarized Light Microscopy" and all current applicable Libby Lab Modification forms as specified in the relevant SAP Analytical Summary Sheet.

PLM-PC400:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," according to ESAT Region 8 SOP PLM-01.01, "Bulk Asbestos Analysis by Polarized Light Microscopy," with the following modification: the Libby Amphibole suite of minerals are included in the tremolite-actinolite results.

PLM-600:

Samples were analyzed by the July, 1993 EPA Test Method (EPA/600/R-93/116), "Method for the Determination of Asbestos in Bulk Building Materials," according to ESAT Region 8 SOP PLM-01.01, "Bulk Asbestos Analysis by Polarized Light Microscopy."

Sample descriptions provided on the results spreadsheet may include both the client description (as listed on the COC) and the laboratory's description observed during stereomicroscopic examination when the two are different. The client description is listed first, then the laboratory's description is listed in brackets. For example, the COC may list "Floor tile" and the laboratory observes a green floor tile; the results will list "Floor tile [green]".

Additional Comments:

ANALYTICAL TEST REPORT

Bulk Asbestos Analysis by PLM-Grav
ESAT Region 8 PLM Laboratory Statement of Uncertainty

The primary factor that contributes to random uncertainty of a PLM-600, PLM-VE and PLM-Grav analytical measurement is determined by the repeatability of an analysis. PLM-Grav analyses have additional uncertainty in a measurement due to the analytical balance which was calculated by the manufacturer as 0.1mg or 0.0001g. The following factors were identified to contribute to systematic uncertainty: sub-sampling of soils during preparation, variation in slide loading between analysts, interferences such as particles with similar optical properties as asbestos, ambiguity in the methods, and differences in analyst interpretation. Uncertainty contributed by field sampling conditions, soil grinding during the sample preparation at the Troy SPF, and shipment of samples is outside the laboratory's control and will not be evaluated by ESAT.

At the inception of the Libby Asbestos Superfund Site (referred to as the Libby Site), the EPA drafted reporting ranges called Bin Categories to further characterize the detection and quantification of asbestos at or below 1%. The majority of samples analyzed by ESAT are Non Detect (ND) or Trace (TR) as defined in site-specific SOP SRC-LIBBY-03 (current revision). With samples containing such a small quantity of asbestos, and the subjective nature of the PLM analytical method, uncertainty is virtually non-quantifiable in traditional statistical methodology. Therefore, zeros in the Quantitative Error table below are indicative of an analyst's reported result within one bin category difference of the original analytical results.

In addition to the quantitative error for client soil samples (stated below), analyst and laboratory accuracy, precision, and bias are determined from monthly reference slides, client samples, Round Robin samples, and NVLAP PE samples per NVLAP requirements (NIST Handbook 150-3 section 5.6 and 5.8) to maintain proficiency with bulk asbestos samples and standards.

Data Tables:

Quantitative Error (calculated using annual data from client QC samples in 2016)

Analyst Initials:	DK	NT	ND	JB	LB	FL	EO
Client QCs Analyzed	16	27	21	181	205	21	136
Client QC Error	0%	0%	4.8%	0%	0%	0%	0.7%

The data within the above table represents annual data from January - December 2016. Monthly updates to this table can be found in the monthly PLM QC Summary.

Qualitative Error (expressed as a percent of the total number of QC analyses for the ESAT Laboratory)

Total percentage of qualitative errors for the 2016 calendar year:	0.7%
Cumulative qualitative error rate from September 2007 - December 2016:	0.095%

Calculations:

Weight Percent

$$W_a = \frac{P_a * V_a * 100}{(100 - V_a) * P_m + (V_a * P_a)}$$

W_a = Weight % of a particular asbestos type
V_a = Volume % of asbestos
P_a = Density of Asbestos
P_m = Density of Matrix

Gravimetric Weight Percent

$$C_{\%} = \left(\frac{|W_a - W_s|}{W_s}\right) * 100$$

$C_{\%}$ = % concentration of a particular asbestos type
W_a = Overall weight of Sample
W_s =Weight of asbestos removed from sample

References:

Stewart, I. U. S. Department of the Interior, Environmental Protection Agency. (1988) Asbestos Content in Bulk Insulation Samples: Visual Estimates and Weight Composition . Washington D. C. : Office of Pesticides and Toxic Substances. EPA/560/5-88/011.

Taylor, J. (1997). *An introduction to error analysis: The study of uncertainties in physical measurements* (2nd ed.). Sausalito, Calif.: University Science Books.

Verkouteren, J. U. S. Department of Commerce, National Institute of Standards and Technology. (1997) Guide for Quality Control on the Qualitative and Quantitative Analysis of Bulk Asbestos Samples: Volume 1 . Galthersburg, MD: NISTR 5951.

PLM-Grav Analysis Results

Laboratory Name: ESATR8 **Job Number:** A170059 **Date Received:** 04/25/2017 **SOP Name/Method:** SRC-LIBBY-01 (REV 3)

Client Sample Number	Tag	Lab Sample ID	QC Type	Date Analyzed	Analyst Name	Deviation	Homogeneous	Sample Weight (g)	Libby Amphibole (LA)			Other Amphibole (OA)				Chrysotile (CH)			Analysis Status	Analysis Comments
									Qual	Weight (g)	CONC %	Qual	Type	Weight (g)	CONC %	Qual	Weight (g)	CONC %		
BG-00332	C2	A170059-01	NOT QC	04/28/2017	E. Orthun	No	Yes	17.6826	ND			ND				ND			Analyzed	Coarse and fine material observed
BG-00336	C3	A170059-02	NOT QC	04/28/2017	E. Orthun	No	Yes	10.2685	ND			ND				ND			Analyzed	Coarse and fine material observed

LIBBY ASBESTOS SUPERFUND SITE
ANALYSIS BENCH SHEET (PLM-Grav)

Client Sample No.	Tag	Lab Sample ID	QC Type	Date Analyzed	Analyst Initials	Deviation	SAMPLE MASS (g): Wt of Empty Container	SAMPLE MASS (g): Wt of Sample + Container	STEREOMICROSCOPIC EXAMINATION: Sample Color [1]	Sample Type/Texture	Homogeneity	Type and % Non-Asbestos Fibers	Non-Fibrous Matrix Materials (if known) [2]	MASS OF ASBESTOS PARTICLES (g): LA-Qual	Wt of Empty Container	Wt of LA + Container	OA-Qual	OA Type	Wt of Empty Container	Wt of OA + Container	CH-Qual	Wt of Empty Container	Wt of CH + Container	ASBESTOS OPTICAL PROPERTIES BY PLM: Habit [3]	Fiber Color [1]	Sign of Elongation	Pleochroism	Extinction Angle [4]	Ref. Index (α)	Ref. Index (γ)	Birefringence [5]	RI Determined By [6]	Temperature (°C)	Comments [7]
BG-00332	C2	A170059-01	(NOT QC) LDC LDS	4/28/17	ED	Yes (No)	1.2984	18.9810	T	(Soil) Sand Fine (Coarse)	(Yes) No	~~___ CELL ___ FBGL ___ OTHR ___ SYN~~	(R) (S)	(ND) TR DET			(ND) TR DET	AMOS CROC ANTH			(ND) TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		(1) 2 3 (4)
BG-00336	C3	A170059-02	(NOT QC) LDC LDS	4/28/17	ED	Yes (No)	1.2953	11.5638	T	(Soil) Sand Fine (Coarse)	(Yes) No	~~___ CELL ___ FBGL ___ OTHR ___ SYN~~	(R) (S)	(ND) TR DET			(ND) TR DET	AMOS CROC ANTH			(ND) TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		(1) 2 3 (4)
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4
			NOT QC LDC LDS			Yes No				Soil Sand Fine Coarse	Yes No	___ CELL ___ FBGL ___ OTHR ___ SYN	R S	ND TR DET			ND TR DET	AMOS CROC ANTH			ND TR DET			AF NAF		POS NEG	YES NO	I P			L M H	BL DS		1 2 3 4

[1] BL = Blue, BR = Brown, C = Colorless, G = Gray, GR = Green, R = Red, T = Tan, V = Violet, Y = Yellow; [2] R = Rocks, S = Soil; [3] AF= Asbestiform, NAF=Non-Asbestiform; [4] I = Inclined, P = Parallel; [5] L = Low, M = Moderate, H = High; [6] BL = Becke Lines, DS = Dispersion Staining; [7] 1 = Coarse and fine material observed, 2 = PLM-1, 3 = PLM-2, 4 = Balance-1